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Vol. 34, Part 4 1951

SOME AGARICACEAE OF TRINIDAD AND VENEZUELA. LEUCOSPORAE: PART I

By R. W. G. DENNIS

Royal Botanic Gardens, Kew, Surrey

(With Plates 19–23 in colour, 61 Text-figures and 2 Maps)

Detailed descriptions are given from living material of 107 species and varieties belonging to the genera: *Marasmius*, *Crinipellis*, *Chaetocalathus*, *Collybia*, *Microm-phale*, *Mycena*, *Dictyoploca*, *Tricholomopsis* and *Tricholoma*, collected in the autumn of 1949 in Trinidad, Venezuela and Jamaica. After comparison with herbarium material, twenty-nine of the species and six varieties are named as new. Eighty species are illustrated in colour.

During the autumn of 1949 the writer was privileged to spend three months collecting agarics in Trinidad, British West Indies. Some collections were also made during visits of one week to Venezuela and two days to Tobago. Most collections were made in more or less natural forest, but a considerable number came from plantations of cacao and bamboo, the latter introduced from the eastern tropics and formerly cultivated as a source of pulp for paper manufacture. The localities visited are shown on Maps 1 and 2 and are listed in Table 1. This should be read in conjunction with the admirable account of the climate, soils, and vegetation of Trinidad by Beard (1946).

The usual practice was to collect on two days each week, return to the laboratory at night, place collections to spore overnight and spend the following two or three days in working on them. Material not examined on the day following collection was kept in a refrigerator until required. Water-colour sketches were made of all collections and spores, hymenial elements and cuticular structure were examined in the fresh material. All specimens examined were then dried, usually in an electric oven, but in an ordinary gas stove in Venezuela. Once thoroughly dried all collections were kept in desiccators with calcium chloride and finally packed in tins with small perforated containers of calcium chloride for transport to England. These precautions are essential during the wet season, as otherwise collections dried during the day become moist again at night and are attacked by moulds. Spirit or formalin material is not satisfactory as its hyphal structure is liable to be distorted and, as Metrod (1949) has pointed out, one can no longer determine the essential iodine reactions. These requirements make it useless to attempt collecting Agarics in the wet tropics unless one is able to return at least every two days to a base with some simple laboratory equipment.

On the return voyage a fortnight was spent in Jamaica. Here very few collections could be made in the low country owing to dry weather. Agarics were abundant at elevations over 5000 ft. in the Blue Mountains but these were largely of temperate facies and had little in common with those of Trinidad. They are therefore reserved for a subsequent paper.

Vol. 34, *Part* 3: *issued* 28 *September* 1951.

The present paper deals with the *Marasmius-Collybia-Mycena-Tricholoma* complex, a group of genera even more difficult to disentangle in the tropics than in Europe. My specimens are in Herb. R. B. G. Kew.

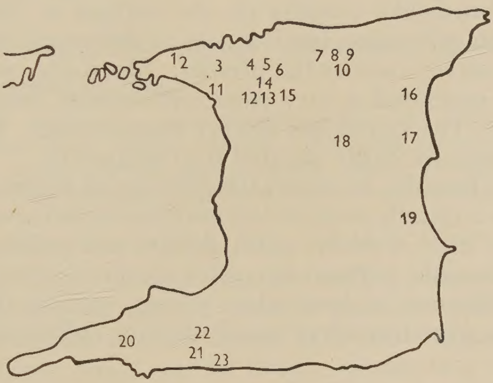
The primary problem of the collector faced by an entirely unfamiliar agaric flora is not to name his species but to decide how many species he has to deal with. When his opportunity for field work is restricted to a few months he cannot hope to secure that appreciation of the true characters of a species which comes only by handling a long series of collections. Hence he may easily be misled by variation in superficial features and is prone to describe collections rather than species. From this ever present source of error I cannot hope to have escaped; I can only aim at providing a basis on which mycologists resident in the West Indies can build, abolishing redundant species and adding others, until eventually a true picture of this rich and varied agaric flora is obtained.

Table 1. *List of localities, altitudes and types of vegetation*

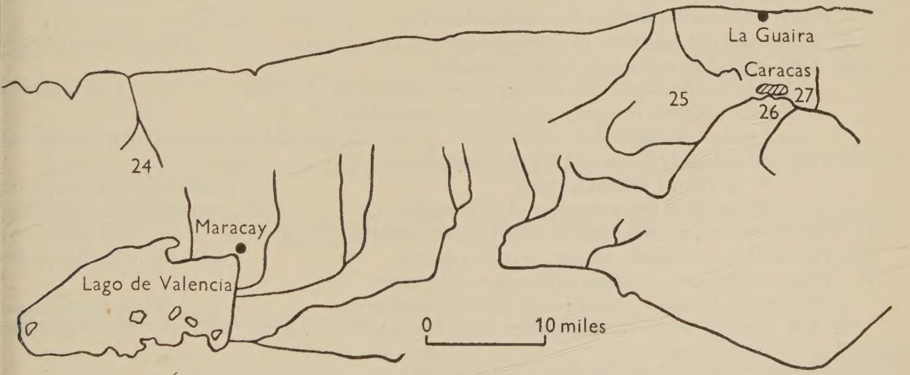
Localities	Altitude (ft.)	Type of vegetation
	Trinidad (Map 1)	
1. Maqueripe Trail	500–700	Secondary rain forest
2. Diego Martin	150	Cacao plantations
3. Santa Cruz	400	Cacao plantations
4. El Tucuche	2000–3000	Lower montane rain forest
5. Naranja	2000	Lower montane rain forest
6. Upper Caura valley	1000	Lower montane rain forest
7. Northern range north of Arima	2000	Lower montane rain forest
8. Morne Bleu	2000–2700	Lower montane rain forest
9. Aripo	1500–2000	Lower montane rain forest
10. L'Orange, Aripo Valley	600	Plantations
11. Port of Spain	25–100	Savanna and botanic garden
12. St Joseph	25	Bamboo plantation
13. St Augustine	50	Banana plantations and savanna
14. Mount Tabor	1000–1500	Degraded deciduous seasonal forest
15. Tacarigua	50	Savanna
16. Matura Forest	100	Evergreen seasonal forest, mora type
17. Non Pareil, Sangre Grande	100–500	Cacao and hevea plantations
18. Arena	100	Evergreen seasonal forest
19. Cocal	0	Coconut plantation
20. Erin	50–200	Evergreen seasonal forest
21. Siparia Forest Bungalow	100	Semi-evergreen seasonal forest
22. Siparia Forest Reserve	100	Evergreen seasonal forest
23. Quinam	0–100	Semi-evergreen seasonal forest
	Venezuela (Map 2)	
24. Rancho Grande, Maracay	3000–4000	Lower montane rain forest
25. El Junquito	6300	Cloud forest
26. Botanic Garden, Caracas	3000	Denuded hills and scrub
27. Rio Chacaito	3000	Thin seasonal forest

Identification of tropical agarics described by nineteenth-century mycologists from dried collections sent to Europe is a discouraging task. Very few species can be recognized from their descriptions, and even when the types are accessible it is seldom that sufficient diagnostic characters can be recovered to place an indentification beyond cavil. Wright's Cuban fungi, described by Berkeley and Curtis in 1869, were in a very bad condition, almost invariably overgrown by moulds, and it is difficult to forgive these authors' presumption in inflicting so many binomials on the mycological world based on such worthless material.

Gardner's and Spruce's collections on which other species were founded are also at Kew, as are co-types of many of Montagne's French Guiana species, sent by him to Berkeley. Other of Montagne's types I have been permitted to borrow from Paris. The types of Murrill's West Indian agarics, described in the *North American Flora*, are mostly in good condition n the New York Botanic Garden, and have been made available to me on loan. So have Spegazzini's species of *Marasmius* from the Argentine, Paraguay and Brazil, now carefully preserved at La Plata. Fries (1851) described several species of agarics from specimens collected by Benzon in the Virgin Islands, then Danish territory, and from drawings made by Oersted there and in Costa Rica. These are at Copenhagen whence the latter have been courteously sent on loan to Kew. Tentative identifications of a few of them are suggested in the text. Oersted's drawings were accompanied by specimens in spirit, but neither these nor Benzon's collections can now be traced at Copenhagen or Uppsala.



Map. 1. Localities of Trinidad collections.



Map. 2. Localities of Venezuelan collections.

Even when as many identifications as appear plausible have been made with accessible types there remains an alarmingly large number of unidentified collections. To provide West Indian mycologists with labels for these I have described them as 'new' species but it is highly probable that many, perhaps most, of them will in time be found to have been named before from some part of the world. The colour nomenclature adopted in the diagnoses is that of Ridgway (1912).

MARASMIUS Fr., *Flor. scan.* p. 339, 1835

Type species: *Agaricus rotula* Scop. ex Fr.

If *Marasmius* is interpreted narrowly in the sense of *Agaricus rotula* it becomes a synonym of *Androsaceus* Pat. This is based on a single character, the presence of brush-like cystidia on the surface of the pileus, and is perhaps not a 'natural' genus, but it is easy to define and hence very useful in a preliminary survey such as the present. Moreover, with this peculiar pileus surface is associated a wiry stem and usually, not always, a long tear-shaped spore. The spores are always non-amyloid. In this sense the species of *Marasmius* are easily divided into two series:

(*a*) *Collariati* F. Bataille, in which the gills are all equal and attached to a collar, the pileus is usually more or less umbilicate and always has a central black papilla, the stipe is always dark, slender and polished.

(*b*) *Radiati* F. Bataille, without the collar round the apex of the stipe, the pileus usually umbonate, at least when young, without the central black dot, and with the stipe less wiry, usually lighter coloured and sometimes finely downy.

I. Gills attached to a collar surrounding the apex of the stipe:
A. Pileus white to very pale flesh coloured *M. rotuloides*
B. Pileus reddish brown or cinnamon-buff:
a. Gill edge concolorous or pinkish, spores 14–17 × 3 μ. *M. rubromarginatus*
b. Gill edge not coloured, spores shorter:
1. Pileus cinnamon-buff, sporophores caespitose on bark. *M. aciculaeformis*
2. Pileus reddish brown, sporophores scattered:
α. Umbo prominent. *M. trichorhizus* var. *aripoensis*
β. Umbo a minute dot in the umbilicus:
* Without rhizomorphs. *M. graminum* var. *brevispora*
** Arising from slender rhizomorphs. *M. graminum* var. *equicrinis*
C. Pileus yellow, in swarms on dead leaves, spores 11–14 × 3 μ. *M. guyanensis*
D. Pileus clay coloured, spores 7–10 × 3·5–5 μ. *M. peckii*
E. Pileus dark grey or sepia, gill edge coloured:
a. On dead bamboo, associated with rhizomorphs. *M. griseoviolaceus*
b. On bark of logs, much smaller than the above. *M. arimana*

II. Gills free or adnate to the apex of the stipe:
A. Spores star-shaped. *M. nigripes*
B. Spores elliptical or tear-shaped:
a. Without a characteristic smell:
1. Pileus light orange or shading to yellowish:
α Gills conspicuously interveined *M. polyporoides*
β. Gills not interveined *M. leoninus*
2. Pileus bright red. *M. haematocephalus*
3. Pileus white:
α. Sporophores scattered on dead leaves:
* Gills distant:
† Pileus over 1 cm. diameter, spores 12–15 × 3 μ. *M. haedinus*
†† Pileus up to 1 cm. diameter, spores 9–12 × 3–3·5 μ. *M. subrotula*
** Gills crowded *M. haedinus* var. *minor*
β. Sporophores arising from white rhizomorphs. *M. pseudoarachnoideus*
γ Sporophores minute, short stalked, on grass stems. *M. paspali*

4. Pileus purple. *M. tageticolor*
5. Pileus brown or reddish brown:
    α. Spores tear-shaped, 14–19 × 4–5 μ:
        * Gills distant, edge white, on bark or wood. *M. helvolus*
        ** Gills subdistant, edge coloured, on leaves. *M. ferrugineus*
    β Spores elliptical, 8–11 × 4–5 μ. *M. pruinatus*
    γ Spores narrow cylindric, 7–8 × 2–5 μ, gills with cylindrical cystidia. *M. cystidiophorus*
6. Pileus clay-coloured, stipe downy. *M. actinopus*
7. Pileus olive-brown *M. trinitatis*

b. With a smell of garlic *M. subingratus*

Collariati F. Bataille, *Flore Monogr. Marasmius d'Europe*, p. 26, 1919

Marasmius rotuloides sp.nov.

Pileus orbicularis 1·5 cm. latus, tenui-membranaceus, convexiusculus, sulcato-striatus, centro subumbilicato, albus; lamellae remotae 3 mm. latae, in collarium liberum postice conjunctae, albae; stipes corneus, rigidus, tenuis, glaber, obscure testaceus vel ater; pelliculae celluli ovoideo-rotundati 15 μ diam.; sursum verrucosi, hyalinis; sporae ovatae 5 × 2·5 μ, hyalinae.

Ad folia dejecta putrescentia in sylvis, Aripo, Trinidad. Dennis 232 Typus.

Pileus up to 1·5 cm. diameter, convex with a conspicuous but shallow umbilicus containing a minute central papilla, striate-sulcate to the umbilicus, white to pale flesh coloured; flesh thin and membranous, white. Gills distant, equal, about 3 mm. broad, adnate to a conspicuous collar surrounding the apex of the stipe, concolorous with the pileus. Stipe cylindrical, horny, slender, dark red-brown to black, the apical few millimetres whitish, smooth and polished throughout. Spores ovoid, non-amyloid, about 5 × 2·5 μ, spore print white. Pileus surface formed of colourless, thin-walled, pear-shaped cystidia with short processes about 15 μ diameter. (Pl. 19, fig. 14.)

Attached to dead leaves in litter of montane forest.

Dennis 232, about 2000 ft. on Cerro del Aripo, Trinidad, 23 October 1949 (Typus).

This species is closely allied to *M. rotula*, from which it differs chiefly in its smaller spores.

Marasmius rubromarginatus sp.nov.

Pileus orbicularis 1·5 cm. latus, tenui-membranaceus, convexiusculus, sulcato-striatus, centro subumbilicato, testaceus; lamellae remotae, albae, acie integrae pileo concolores, in collarium liberum postice conjunctae; stipes corneus, rigidus, tenuis, glaber, sordide brunneus vel ater; pelliculae celluli ovoideo-rotundati sursum verrucosi; sporae lanceolatae 14–17 × 3 μ.

Ad fragmenta dejecta in sylvis, Mt Periquito, Venezuela. Dennis 339 Typus.

Pileus up to 1 cm. diameter, convex with a well-marked shallow umbilicus, striate-sulcate to the centre, mahogany-red; flesh thin, membranous, white. Gills whitish with a conspicuous pink border, attached to a well-developed collar surrounding the apex of the stipe. Stipe cylindrical, horny, slender, dark grey-brown to blackish, apex white, smooth and polished throughout. Spores tear-shaped, non-amyloid, 14–17 × 3 μ. Pileus surface formed of cystidia with short red papillae, gill edge of similar cystidia about 17 × 7–8 μ. (Pl. 19, fig. 4.)

On litter on the ground in montane forest.

Dennis 339, Mount Periquito, Rancho-Grande, Maracay, Venezuela, 22 November 1949 (Typus).

Marasmius graminum (Lib.) Berk. var. **brevispora** var.nov.

A typo differt sporis minoribus 7–9 × 4–5 μ.

Ad folia dejecta Bambusae, St Joseph, Trinidad. Dennis 411 Typus.

Pileus up to 4 mm. diameter, convex with a very shallow umbilicus and a low black central papilla, slightly striate-sulcate to the umbilicus, orange-rufous; flesh white, membranous. Gills and under surface of the pileus white, gills broad, equal, about twelve, adnate to a collar surrounding the apex of the stipe. Stipe cylindrical, equal, horny, slender about 3 cm. long, reddish brown, smooth and polished. Spores elliptical, hyaline, 7–9 × 4–5 μ. (Pl. 19, fig. 15.)

Occurring singly on dead and fallen leaves of bamboos.

St Joseph, Trinidad, 30 November 1949, Dennis 411 (Typus).

This collection seems too near the European *M. graminum* to rank as a distinct species, but the spores of British material are about 12 × 6 μ, and Lange found them 9–12 × 4–5 μ in Denmark. What is probably the same species as the Trinidad fungus was described from the Bonin Islands as *M. exustus* Berk. & Curt. 1879. The type is not at Kew and it is uncertain whether its gills were attached to a collar or not, but as the pileus was described as umbilicate a collar was very probably present. Specimens under *M. exustus* from Cuba in the Berkeley herbarium are very like the Trinidad collection. *M. curreyi* Berk. & Broome, 1879, is said to have spores 9 × 5–6 μ and may thus be this short-spored form of *M. graminum*. The type at Kew has eight gills attached to a collar but I have not felt justified in searching it for spores. Bataille seems to have met with a similar form in France for he describes *M. graminum* as having spores 8 × 4 μ. *M. graminicola* Speg. is superficially similar, but in the type I could detect no collar and on its gills were a few spores 17 × 5 μ. It thus seems more closely allied to *M. pruinatus* Berk. & Curt.

Marasmius graminum (Lib.) Berk. var. **equicrinis** (Mueller) comb.nov.

Marasmius equicrinis Mueller apud Berk., *J. linn. Soc.* (*Bot.*), **18**, 383–384, 1881.

Differs from the type mainly in the sporophores arising from a fine black rhizomorph. Petch's description of Ceylon material agrees tolerably with the types from Richmond River, New South Wales, and applies to a fungus which seems too near *M. graminum* to be treated as more than a rhizomorphic variety of that species.

To it may be referred two Trinidad collections with spores 10–11 × 4–5 μ and the gill edge dotted with reddish brown cystidia with short processes, viz. River Estate, Diego Martin, creeping over dead bamboo leaves on the ground, 29 September 1949; Arena Forest, on litter, 1 December 1949.

There is also in Herb. Kew under this name a collection of sterile rhizomorphs received 9 September 1909. These are stouter than the above and recall rather those of *M. griseoviolaceus* Petch.

Marasmius trichorhizus Speg. var. **aripoensis** var.nov.

A typo differt mycelio rhizomorphoideo deficiente.
In foliis dejectis in sylvis, Cerro del Aripo, Trinidad. Dennis 231 Typus.

Pileus about 2 mm. broad, sulcate to the disk, mahogany red, with a prominent black umbo; flesh thin white. Gills about eight, broad, adnate to a collar round the apex of the stipe, pale buff. Stipe very slender and wiry, black and polished throughout. Spores elliptical 6–8 × 3 μ. Surface of the pileus formed of pear-shaped cystidia about 7 μ across, with short dark-red processes. (Pl. 19, fig. 16.)

On fallen leaves of *Inga* and other trees in forest.

Dennis 231, about 2000 ft., Cerro del Aripo, 23 October 1949 (Typus).

The type of *M. trichorhizus*, 'Caa Guazu 1880', is apparently lost, but there is in Herb. Spegazzini a collection named by him from Pirayu, July 1879. This is on bark and, as the name implies, has a copious development of black hair-like rhizomorphs from which a few sporophores arise. The latter are indistinguishable from those of Dennis 231. They have the same prominent black umbo, and the spore size as given by Spegazzini is 7–8 × 4–5 μ. Rhizomorph development seems to be a very variable character in *Marasmius* and I do not feel justified in describing the Trinidad collection as a new species based only on the absence of rhizomorphs. Part of Leprieur 991 in Herb. Montagne under the name *M. dispar* may well be the same as the Trinidad fungus, but the type of *M. dispar* Mont. has much longer stouter stipes and, if Montagne's sketch can be trusted, it had free gills.

Marasmius guyanensis Mont., *Ann. Sci. nat.* (*Bot.*), Ser. 4, **1**, 114, 1854

Pileus up to 6 mm. diameter, convex with a small central umbilicus containing a well-marked black apical papilla, deeply striate-sulcate to the umbilicus, yellow-ochre; flesh thin and membranous. Gills about ten, distant, equal, broad, adnate to a conspicuous collar surrounding the apex of the stipe, concolorous with the pileus. Stipe cylindrical, horny, slender, dark red-brown to black, apex yellow-ochre, smooth and polished throughout. Spores tear-shaped, 11–14 × 3 μ, hyaline, non-amyloid. Pileus surface formed of small cystidia bearing yellow-ochre papillae, gill edge formed of similar but colourless cystidia. (Pl. 19, fig. 17.)

In swarms on dead and fallen leaves of deciduous trees in lowland forest.

Collections seen.—French Guiana: authentic material from Montagne. Trinidad: Arena Forest, 30 October 1949, on leaves of *Carapa guianensis*, Dennis 255.

The type of *Marasmius hiorami* Murrill agrees in every character of the sporophore but has associated sterile rhizomorphic strands. It is on dead leaves and twigs from San Juan de Puerto Rico, November 1912. The type of *M. chrysochaetes* Berk. & Curt. is superficially similar but has a more prominent umbo, and its cuticular cells apparently bear no processes. Singer (1942) has transferred it to *Crinipellis*.

Marasmius peckii Murrill, *N. Amer. Flora*, **9**, 255, 1915

Pileus about 5 mm. diameter, convex to almost flat, slightly depressed round the central minute black papilla, striate to the centre, clay colour; flesh thin, white, membranous. Gills about eight, narrow distant, adnate to a shallow collar surrounding the apex of the stipe, white like the under side of the pileus. Stipe very slender, wiry, blackish, smooth and polished. Spores elliptical, 7–10 × 3·5–5 μ. (Pl. 19, fig. 9.)

On dead and fallen leaves.

Collections seen.—British Honduras: M. E. Peck, 1906, on dicotyledonous leaves (Typus). Trinidad: Siparia, 3 November 1949, Dennis 275, on *Maximiliana* leaflets. Jamaica: Castleton Botanic Garden, 16 November 1949, Dennis 275A, on palm leaflets in a rubbish heap.

Marasmius griseoviolaceus Petch, *Trans. Brit. mycol. Soc.* **31**, 42, 1947

Pileus up to 7 mm. diameter, convex, the centre slightly depressed around a low black papilla, striate-sulcate to the disk, fuscous; flesh thin, white. Gills distant, equal, attached to a well-developed collar surrounding the apex of the stipe, white like the under side of the pileus, their edges dotted with black. Stipe cylindrical, long, stiff and wiry, hollow, black, smooth and polished throughout. Spores elliptical, 9–11 × 4–5 μ. Surface of the pileus formed of pear-shaped cystidia bearing numerous short, blackish processes, similar cystidia about 10 μ in diameter, form the coloured gill edge. (Pl. 19, fig. 18.)

On fallen bamboo twigs and, exceptionally, on the leaves, usually associated with long undulating wiry black rhizomorphs.

Dennis 409, St Joseph, Trinidad, 30 November 1949. Several earlier collections from the same locality were sterile.

M. polycladus Mont. is similar but has much stouter rhizomorphs than any of the abundant material seen in Trinidad. Spores on an authentic specimen of *M. polycladus* sent by Montagne to Berkeley measure 7 × 3 μ.

Marasmius arimana sp.nov.

Pileus 2–3 mm. latus, tenui-membranaceus, convexiusculus, sulcato-striatus, centro subumbilicato, sepiaceus; lamellae remotae, bubalinae, acie integrae pileo concolores, in collarium postice conjunctae; stipes corneus, tenuis, ater; pelliculae celluli ovoideo-rotundati, sursum verrucosi; sporae lanceolatae, hyalinae 11–14 × 3·5–4 μ.

Ad corticem truncorum putrescentium, Arima, Trinidad. Dennis 391 Typus.

Pileus 2–3 mm. diameter, convex with a shallow umbilicus, striate-sulcate to the centre, sepia or mummy-brown; flesh thin, white, membranous. Gills distant, equal, of moderate width, attenuated at each end, attached to a shallow collar forming little more than a ridge round the apex of the stipe, pale buff like the under side of the pileus, edges sepia. Stipe slender, wiry, almost black, smooth and polished throughout. Spores tear-shaped, non amyloid, 11–14 × 3·5–4 μ. Pileus surface formed of pear-shaped cystidia, with reddish brown processes. Similar cystidia 8 μ across form the coloured gill edge. (Pl. 23, fig. 5.)

Dennis 391, on bark of dead logs, Arima, Trinidad, Miss Dora Kong, 28 November 1949 (Typus).

M. phaeus Berk. & Curt. has a paler stipe with strigose base and a more campanulate pileus.

Marasmius aciculaeformis Berk. & Curt., *J. linn. Soc. (Bot.)*, **10**, 297, 1869

Marasmius pallipes Speg., *An. Soc. cient. argent.* **16**, 274, 1883.

Pileus up to 5 mm. diameter, convex with a central depression surrounding a minute brown dot, striate-sulcate to the disk, cinnamon-buff; flesh thin, white. Gills broad, mostly equal, adnate to a well-developed collar round apex of the stipe, white or pale buff. Stipe wiry, undulating, slender, chestnut below, shading through yellowish to white at the apex, smooth and shining. Spores elliptical, hyaline, 7–12 × 5–6 μ. Surface of the pileus formed of pear-shaped cystidia with very short processes, similar cystidia about 13 μ diameter occur on the gill edge. (Pl. 20, fig. 5.)

In dense swarms on bark.

Collections seen.—Cuba: Wright 121 as *M. aciculaeformis*; Wright 152 and 153 in Herb. Berk. as *M. acicularis* Berk. & Curt. Trinidad: on living roots of *Ficus benjamina*, Botanic Garden, Port of Spain, 25 November 1949, Dennis 375. Paraguay: Guarapi, March 1880, Balansa 3379 (Typus of *Marasmius pallipes*).

The type of *M. acicularis* Berk. & Curt. 1858 was from the Bonin Islands and is not in Berkeley's Herbarium. Hence I have used the later name *M. aciculaeformis* of which the type has been seen.

Radiati F. Bataille, *Flore Monogr. Marasmius d'Europe*, p. 27, 1919

Marasmius leoninus *Berk.*, Hooker's *J. Bot.* **8**, 135, 1856

Marasmius rhabarbarinus Berk., Hooker's *J. Bot.* **8**, 135, 1856.

Pileus 1·5–5·0 cm. diameter, convex, then expanded, sometimes slightly depressed, margin often undulating, somewhat feebly striate, orange-chrome to ochraceous-orange; flesh white below the cuticle of the pileus, thin. Gills moderately spaced, not at all connected by veins or only at the end of the shorter lamellae; of three lengths, rather narrow, up to 4 mm. wide in very large specimens, attenuated at each end, adnexed, pale buff. Stipe long, cylindrical, 1–2 mm. thick, hollow, smooth and polished throughout, dark purplish brown below, white at the apex. Spores 14–17 × 3–3·5 μ, tear-shaped, spore print white. The surface of the pileus and edge of the gills are formed of cystidia 8–10 μ diameter, with long yellow processes about 7–9 × 1 μ. Scattered over the hymenium are irregularly cylindrical cystidia with rounded tips and yellow contents, not protruding above the level of the basidia. (Pl. 19, fig. 1.)

Scattered on dead leaves and litter in plantations.

Collections seen.—Trinidad: bamboo plantation, St Joseph, 27 September 1949, Dennis 42A; same locality, 7 September 1949, Dennis 42B; River Estate, Diego Martin, September 1949, Dennis 42; Siparia, 3 November 1949; Cedros, E. M. Wakefield 22 January 1929. Brazil: Panuré, 'ad folia emortua in sylvis', March 1853, Spruce 112 (Typus); Panuré, Spruce 140, March 1853, Typus of *M. rhabarbarinus*; Rio Purua, Trail 161, as *M. rhabarbarinus*.

Towards the end of the rainy season a paler coloured form, Dennis

42 D 2, with spores 8–12 × 3–3·5 μ, appeared on the bamboo debris which had previously carried Dennis 42 A and B. A similar pale form Dennis 42 D on Queen's Park savanna, Port of Spain, 25 November 1949, had spores 12–15 × 3–3·5 μ. I do not at present feel these forms are specifically separable.

Dennis 131, Arena Forest, 5 October 1949; and 131 A, Botanic Gardens, Port of Spain, 25 November 1949; are a similarly coloured fungus with more campanulate pileus only 8 mm. across, crowded gills and spores 6–8·5 × 3 μ, growing on dead logs. This may be a good species, but the collections were too scanty for one to feel sufficient confidence in its individuality.

Marasmius polyporoides Murrill, *N. Amer. Flora*, **9**, 226, 1915

Pileus 1–2 cm. diameter, hemispherical, then convex or expanded with a shallow umbilicus, smooth, ochraceous-orange; flesh thin, tough, pale buff. Gills crowded, narrow, adnate, of two to three lengths, closely reticulately interveined, pale buff, occasionally becoming mauve in age. Stipe cylindrical, equal, hollow, purplish brown below, shading to pale buff at the apex, very minutely pruinose with cylindrical, obtuse, thin-walled hairs, up to 30 × 8 μ, the base often surrounded by radiating white or cream hyphae. Spores tear-shaped, 9–11(–14) × 3–4 μ. Cuticle of the pileus formed of pear-shaped cystidia with ochraceous processes, gill edge of similar but hyaline bodies about 6 μ diameter. (Pl. 19, fig. 2.)

Occurring singly on dead leaves in forest litter.

Collections seen.—Trinidad: Arena forest, 5 October 1949, Dennis 133; and same locality, 30 October 1949; bamboo plantation, St Joseph, 7 October 1949, Dennis 133 A; L'Orange, Aripo, 13 October 1949, Dennis 133 B. British Honduras: October 1906, M. E. Peck (Typus).

Smith (1939) has fully described a further collection from Valentin, El Cayo, British Honduras, made 26 June 1936, E. B. Mains 3628. I suspect *M. cladophyllus* Berk. from Brazil is an earlier name for this fungus. The solitary sporophore in the type collection has a smooth stipe, but this may be due to age. Authentic specimens of *M. rubricosus* Mont. in Berkeley's herbarium resemble *M. polyporoides* in many ways but the gills have no cross partitions.

Marasmius haedinus Berk., Hooker's *J. Bot.* **8**, 135, 1856

Pileus 2–2·5 cm. campanulate with a minute umbo, at first pale buff, becoming pure white at maturity, sulcate-striate; flesh thin, white. Gills distant, narrow, free, equally attenuated at each end, of two lengths. Stipe cylindrical, about 1 mm. thick, hollow, purplish brown below, white above, smooth, seated on a small white or yellowish swollen, hairy foot. Surface of the pileus and edge of the gills formed of colourless cystidia with short processes. Irregularly cylindrical obtuse bodies 6–7 μ wide and 25–50 μ long, with colourless refractive contents like gloeocystidia are abundant in the hymenium. Spores tear-shaped, often curved, hyaline, 12–15 × 3 μ, print white. (Pl. 19, fig. 5.)

On dry fallen sticks or on white patches on dead fallen leaves in montane forest and plantations.

Collections seen.—Brazil: Panuré, March 1843, Spruce 31 (Typus). French Guiana: Leprieur 1085 (in Herb. Montagne, Paris, with *M. niveus*). Trinidad: watershed of northern range north of Arima, 25 September 1949, Dennis 56; bamboo plantation, St Joseph, 18 October 1949, Dennis 56A; beside Tucuche trail, Naranja, 27 November 1949, Dennis 56B. Dominica: on fallen leaves of cacao, Hillsborough (15 November 1920, E. M. Wakefield 36.

Marasmius haedinus var. **minor** var.nov.

A typo differt pileo minoribus.

Ad fragmenta dejecta in sylvis, Siparia, Trinidad. Dennis 57A Typus.

Pileus 5–10 mm. diameter, convex with a minute central umbo, closely sulcate-striate, pure white; flesh thin, white. Gills rather crowded, equal, free, narrow and equally attenuated at each end, white to very pale buff. Stipe cylindrical, slender, wiry, purplish brown below or at first yellowish, white above, slightly expanded at base and apex, smooth. Spores tear-shaped to fusiform, hyaline, $13–15 \times 3{\cdot}5–4\,\mu$. Surface of the pileus formed of colourless cystidia with short processes. Similar cystidia form the white gill edge, and cylindric-fusiform cystidia like those of *M. haedinus* are abundant on the gill face. (Pl. 19, fig. 10.)

Occurring in swarms on forest debris, leaves and sticks.

Collections seen.—Trinidad: Siparia Forest Reserve, 5 November 1949, Dennis 57A (Typus); montane forest on crest of range north of Arima, 25 September 1949, Dennis 57.

form **brevispora** f.nov.

A typo differt sporis minoribus $8 \times 3{\cdot}5\,\mu$. Dennis 138 Typus.

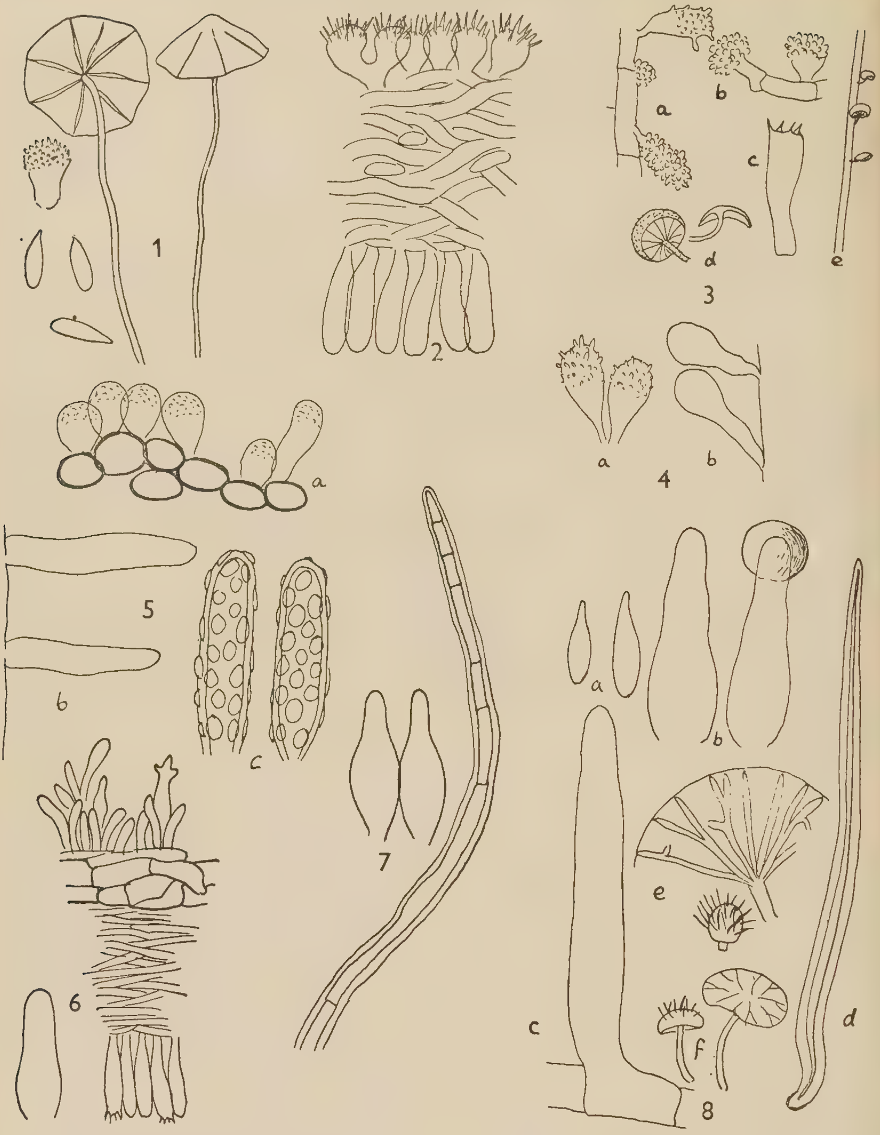
Differs from the above in having spores $8 \times 3{\cdot}5\,\mu$.

Trinidad: Arena Forest, 5 October 1949, Dennis 138 (Typus).

One feels there should be a name for this abundant variety, but it does not fit any of the tropical *Marasmius* described in *N. Amer. Flora*, and is not matched among Murrill's types in the New York herbarium. Certainly it cannot be *M. synodicus* Kunze which had a downy stipe. *M. proletarius* Berk. & Curt. and *M. tener* Berk. & Curt. seem different in their adnate gills. *M. pallipes* Speg. has fewer gills attached to a collar. *M. catervatus* Massee has the striate margin but was figured with adnate gills and a slightly umbilicate pileus. In some ways this variety seems more akin to *M. epiphyllus* Fr.

Marasmius subrotula Murrill, *N. Amer. Flora*, **9**, 259, 1915

Pileus 5–9 mm. conical, sulcate-striate, white to very pale buff; flesh white, membranous. Gills equal, distant, about ten, concolorous, of moderate width almost free and equally attenuated at each end. Stipe cylindrical, wiry, slender, purplish brown, smooth and polished, the base often surrounded by a little white mycelium. Spores tear-shaped, often slightly curved towards the apiculus, $9–12 \times 3–3{\cdot}5\,\mu$. Surface of the pileus formed of pear-shaped cystidia about $10\,\mu$ diameter, covered with short processes, similar bodies form the gill edge. No cystidia noted on the gill face. (Text-fig. 1.)



Text-fig. 1. *Marasmius subrotula:* drawn from the soaked-up type, sporophores, × 5; cystidium and spores, × 660.

Text-fig. 2. *M. pseudo-arachnoideus:* section of pileus, × 660.

Text-fig. 3. *M. paspali:* (*a*) caulocystidea, (*b*) pilocystidea, (*c*) basidium, all × 660; (*d*) sporophores, × 3; (*e*) sporophores on grass stem, natural size.

Text-fig. 4. *M. nigripes:* (*a*) pilocystidia, (*b*) caulocystidia, × 660.

Text-fig. 5. *M. cystidiophorus:* (*a*) section of pileus cuticle, (*b*) hairs of the stipe, (*c*) cystidia, all × 660.

Text-fig. 6. *M. subingratus:* section of pileus, hair from stipe on left, × 660.

Text-fig. 7. *Crinipellis septotricha:* cystidia and hair from pileus, × 660.

Text-fig. 8. *C. stenophylloides:* (*a*) spores, (*b*) cystidia, (*c*) hair from stipe, (*d*) hair from pileus, all × 660; (*e*) partial gill plan in mature sporophore and young sporophore, × 3; (*f*) sporophores, natural size.

Occurring singly on dead leaves, herbaceous stems and twigs in forests and plantations.

Collections seen.—Trinidad: Non Pareil, Sangre Grande, 11 October 1949, Dennis 164; River Estate, Diego Martin, 30 November 1949, Dennis 103. Jamaica: Hope Gardens, 16 November 1902, F. S. Earle 501 (Typus).

This is perhaps too closely allied to *M. haedinus*, from which it differs in the smaller stature.

Marasmius tageticolor Berk., Hooker's *J. Bot.* **8**, 136, 1856

Marasmius sanguineus Cooke & Massee, *Grevillea*, **17**, 59, 1889.
Marasmius atropurpureus Murrill, *N. Amer. Flora*, **9**, 262, 1915.

Pileus 1–2 cm. diameter, campanulate, sulcate-striate, vinaceous purple, drying dark corinthian-purple; flesh thin. Gills distant, equal, narrow, free, attenuated at each end, lilac. Stipe cylindrical, wiry, blackish below, light grey or lilac above, smooth, arising from a small white spot on a dead leaf. Spores hyaline, tear-shaped, 19–21 × 3 μ. Surface of the pileus formed of pear-shaped cystidia with long, reddish apical processes which turn grey in 10% KOH solution; similar cells form the gill edge. Scattered over the hymenium are protruding cylindric-fusiform or undulating, obtuse, refractive cystidia about 25–40 × 7–8 μ. The trama stains deep wine-red in Melzer's reagent. (Pl. 19, fig. 6.)

Collections seen.—Brazil: Panuré, Spruce 37 (Typus). Trinidad: Arena Forest, 2 August 1947, Baker 1488; 30 October 1949, Dennis unnumbered. Dominica: Laion Forest, West Indian Exploration Committee (Typus of *M. sanguineus*); Hillsborough, on cacao leaves, 15 November 1920, E. M. Wakefield. Bahamas: Lake Cunningham, New Providence, 8 September 1904, E. G. Britton (Typus of *M. atropurpureus*).

Marasmius helvolus Berk., Hooker's *J. Bot.* **8**, 136, 1856

Pileus 1–2·5 cm., campanulate then convex or almost flattened, sulcate-striate to the disk, tawny, somewhat darker and wrinkled at the disk, white along the striae; flesh thin, white. Gills distant, equal, free, comparatively narrow and equally attenuated at each end. Stipe cylindrical, flexuous, concolorous with the pileus below, white at the apex, base white-strigose. Spores tear-shaped, hyaline 14–19 × 4 μ. Surface of the pileus formed of pear-shaped cystidia with short brown processes, a line of similar cells occurs on the gill edge. No facial cystidia noted. (Pl. 19, fig. 11.)

Collections seen.—Brazil: Spruce 139 (Typus). Trinidad: Queen's Park Savanna, Port of Spain, on bark of buttress root of *Pachira* sp., 25 November 1949, Dennis 374; Morne Bleu, 4 December 1949.

This seems little more than a colour form of *M. tageticolor*. *M. musicola* Murrill may be a small form of *M. helvolus*. The collector's note with the type from Cuba reads: 'Pileus membranaceous, 1 cm., convex to subexpanded, slightly umbilicate, pale fawn, disk darker, glabrous, somewhat rugose, broadly sulcate, lamellae slightly adnexed, very distant, broad whitish.' The type is now much broken, but enough remains to show it had six gills with spores tear-shaped, 16–19 × 3–4 μ.

Marasmius haematocephalus (Mont.) Fr., *Epicrisis*, **1**, 382, 1838

Agaricus haematocephalus Mont., *Ann. Sci. Nat.* (*Bot.*), Ser. 2, **8**, 369, 1837.

Androsaceus haematocephalus (Mont.) Pat., *J. Bot. Paris*, **3**, 336, 1889.

Pileus 1–1·5 cm. diameter, campanulate, smooth, obscurely umbonate, flame-scarlet; flesh thin, yellow. Gills orange with flame-scarlet edges, crowded, narrow adnate, of four lengths. Stipe cylindrical, wiry, hollow, smooth, at first yellow, becoming brown below or almost black at the base. Spores hyaline, tear-shaped, 8–12 × 3 μ, print white. Surface of the pileus and edge of the gills formed of pear-shaped cystidia with short processes. No facial cystidia observed. (Pl. 19, fig. 7.)

On fallen leaves in forests.

Collections seen.—Trinidad: ridge path from Maqueripe trail to North Post, 27 October 1949, Dennis 246; Arena Forest, 30 October 1949, Dennis 246A; same locality 2 August 1947, Baker 1487.

There is no authentic material of this species at Kew, and the numerous old collections under the name are so discoloured with age that I hesitate to cite them.

Marasmius ferrugineus Berk., *Lond. J. Bot.* **2**, 630, 1843

Marasmius paucifolius Murrill, *N. Amer. Flora*, **9**, 262, 1915.

Pileus up to 1 cm. diameter, conical sulcate-striate to the disk, tawny; flesh thin, white. Gills about fifteen, rather distant, equal, adnate to the stipe, white with tawny margins. Stipe cylindrical, wiry, blackish brown, polished, arising from a small white disk. Spores tear-shaped, often slightly curved towards the apiculus, 14–18 × 4–5 μ. Pileus surface and gill edge alike covered with cystidia bearing brown processes. Numerous, more or less hyaline, refractive, cylindric-fusiform cystidia occur in the hymenium. Trama stains deep purplish brown in Melzer's reagent. (Pl. 19, fig. 3.)

On fallen leaves in forests, etc.

Collections seen.—Brazil: Minos, Gardner (Typus). Trinidad: Cedros, on Cocos debris, E. M. Wakefield 286, 22 January 1921; Arena Forest, 5 October 1949, Dennis 136; again 30 October 1949, Dennis 136A. Puerto Rico: Rio Piedras, J. R. Johnstone, 6 September 1912 (Typus of *M. paucifolius*).

Marasmius pruinatus Berk. & Curt., *Ann. Mag. nat. Hist.* (3) **4**, 295, 1859

Pileus up to 5 mm. diameter, hemispherical or convex, sulcate-striate, sometimes slightly depressed round a central black dot, English-red; flesh thin, white. Gills moderately spaced, equal, about ten to twelve, adnate to the apex of the stipe or almost free, pale buff. Stipe wiry, slender, black, smooth, there are no associated rhizomorphs. Spores ovoid, hyaline, 8·5–11 × 4–5 μ, print white. Pileus surface formed of pyriform cystidia bearing rather long processes. (Pl. 19, fig. 12.)

Occurring singly on dead grass leaves and sheaths.

Collections seen.—New England, Sprague in Herb. Berk. (Typus).

Trinidad: St Augustine, on lawn, 16 October 1949, Dennis 101 B; Cocal, 22 November 1949, Dennis 101 C.

It may be rash to revive the name of a New England fungus unknown to the authors of *N. Amer. Flora* for a species of tropical America. I have, however, soaked up the type of *M. pruinatus* and find it has ten gills, not attached to a collar, brown cystidia with short processes and grew on grass. Its spores have not been identified, though mould spores are plentiful on the specimen. Hence it could be the species described above and one can rarely say more with these century-old dried Agaric types.

Marasmius trinitatis sp.nov.

Subfasciculata; pileus 2 cm. latus, campanulato-convexiusculus, sulcato-striatus, margine crenulatus, olivaceus; lamellae confertiusculae, postice attenuato-adnatae, bubalinae; stipes elongatus, cylindraceus, fistulosus, glaber, apice bubalinus deorsum aurantiacus; pelliculae celluli ovoidei, sursum verrucosi cum papillis 5–6 μ longi; sporae lanceolatae, hyalinae 11–12 × 3–4 μ.

Ad corticem truncorum putrescentium in sylvis, Sangre Grande, Trinidad. Dennis 158 Typus.

Pileus up to 2 cm. diameter, campanulato-convex, sulcate-striate, margin crenate, olive-brown; flesh thin, white. Gills crowded, of three lengths, adnexed, of moderate width, pale buff. Stipe cylindrical, hollow, smooth, polished, Mars-orange below shading to pale buff at the apex. Spores hyaline, tear-shaped, 11–12 × 3–4 μ, print white. Surface of the pileus covered with clavate cystidia bearing dark brown cylindrical processes about 5–6 μ long. (Pl. 19, fig. 8.)

In small clusters on rotting logs.

Trinidad: Non Pareil, Sangre Grande, 11 October 1949, Dennis 158 (Typus); Siparia Forest Reserve, 5 November 1949.

Marasmius actinopus Mont., *Ann. Sci. Nat.* (*Bot.*), Ser. 4, **1**, 112, 1854

Pileus hemispherical to convex, closely striate, clay colour; flesh thin, white. Gills crowded, of three lengths, narrow, adnate to the apex of the stipe, pale buff. Stipe cylindrical, minutely downy with undulating, cylindrical, thin-walled hyaline hairs up to 110 × 6–7 μ, reddish brown below, pale buff above, the base white and strigose. Spores tear-shaped, hyaline, 11–14 × 4 μ. Surface of the pileus and edge of the gills covered with cystidia with short processes. (Pl. 19, fig. 19.)

In clusters on dead sticks in the litter.

Collections seen.—French Guiana: authentic material from Montagne in Berkeley's herbarium. Venezuela: Rio Chacaito, Caracas, 18 November 1949, Dennis 397.

M. inaequalis Berk. & Curt. differs in its polished stipe.

Marasmius pseudo-arachnoideus sp.nov.

Pileus 3–4 mm. latus, tenui-membranaceus, convexiusculus, sulcato-striatus, albus vel bubalinus; lamellae angustissimae, remotae, adnatae, bubalinae; stipes brevissimus, tenuis, albus, glaber; pelliculae celluli ovoideo-rotundati cum papillis hyalinis; sporae lanceolatae, hyalinae 18–19 × 4 μ; mycelium rhizomorphoideum, gracile, album.

Ad ramenta putrida, Diego Martin, Trinidad. Dennis 23 Typus.

Pileus 3–4 mm. convex, deeply sulcate-striate, white or pale buff; flesh very thin, white. Gills distant, equal, four to six, narrow, adnate, pale buff.

Stipe short, smooth, white, slender, arising from a long, slender thread-like rhizomorph. Spores non-amyloid, hyaline, tear-shaped, 18–19 × 4 μ, usually with one large oil drop, print white. Surface of the pileus formed of globose or pear-shaped cystidia with rather long hyaline processes, no cystidia observed in the hymenium. (Pl. 19, fig. 20; Text-fig. 2.)

On dead twigs, the rhizomorphs arising from a small patch of white mycelium.

Trinidad: on sticks in cacao plantation, Diego Martin, 22 September 1949, Dennis 23 (Typus).

This species recalls the description of *M. arachnoideus* Berk. & Curt., but the type collection of that fungus, very poorly preserved, seems to bear angular spores of the 'Rhodophyllus' type.

Marasmius paspali Petch, *Trans. Brit. mycol. Soc.* **31**, 43, 1947

Pileus 2–3 mm. diameter, convex whitish; dotted dark brown under a lens, pruinose, flesh very thin, white, fragile. Gills distant, equal, narrow, not interveined, white. Stipe short, curved, becoming excentric, thin, blackish with a white pruina. Spores elliptical or pip-shaped with a large apiculus, non-amyloid, 8–12 × 5·5–7 μ. Basidia 4-spored, clavate, 25 × 7–8 μ. Cystidia wanting, gill edge fertile. Surface of the pileus formed of hyaline thin-walled hyphae about 4 μ thick, rather closely septate, with clamp connexions, bearing brown cystidia with short processes, 5–6 μ wide singly or in small groups. Pruina of the stipe formed of similar but more elongated colourless bodies attached by a very narrow stalk. (Text-fig. 3.)

Gregarious on dead grass stems.

Trinidad, Arena Forest, W. T. Dale, 5 October 1949, Dennis 132, *Marasmius pruinosulus* Murrill is superficially similar but has a gelatinous trama and lacks the brown cystidia on the pileus.

Marasmius nigripes (Schwein.) Fr., *Epicrisis*, p. 383, 1838

Agaricus (*Mycena*) *nigripes* Schwein., *Schrift. Naturf. Ges. Leipzig*, **1**, 58, 1822.

Heliomyces nigripes (Schwein.) Morg., *J. mycol.* **12**, 93, 1896.

Marasmius graminis Murrill, *N. Amer. Flora*, **9**, 259, 1915.

Marasmiellus nigripes (Schwein.) Singer, *Pap. Mich. Acad. Sci.* **32**, 130, 1948.

Pileus up to 1 cm. diameter, convex with a broad shallow umbilicus, then flattened or reflexed, striate at the margin, glaucous grey, brownish at the umbilicus; flesh thin, white. Gills crowded, narrow, pale cream, adnato-decurrent. Stipe cylindrical, white at the apex, black below with a fine white pruina formed by hyaline obtuse hairs. Spores tetrahedral, with four narrow pointed arms, 8 μ in greatest diameter, non-amyloid, print white. The cuticle of the pileus is formed of cylindric-clavate hyaline cells, some at least of which are covered with short processes like 'cystides-en-brosse'. Cylindric-fusiform cells scarcely protruding beyond the general level are abundant in the hymenium and form the gill edge. (Pl. 19, fig. 13; Text-fig. 4.)

Scattered on vegetable debris.

Collections seen.—Trinidad: on grass rhizomes in a lawn, St Augustine, 21 September 1949, Dennis 6; on herbaceous stems and Saman leaves, St Augustine, 24 September 1949, Dennis 6A; on sticks in montane forest on crest of northern range north of Arima, 25 September 1949, Dennis 6B. Barbados: on sugar cane, Bay Estate, 3 January 1921, E. M. Wakefield. Cuba: on dead rhizomes of Bermuda grass on a lawn, Santiago de las Vegas, 1 June 1905 (Typus of *M. graminis*).

The species is here interpreted in the sense of Morgan and Lloyd (*Mycological Writings* **1**, 46). It appears to be related to Petch's interpretation of *M. subcinereus* B. & Br., which is evidently common in Ceylon, but I have not noted the change of colour on bruising described by Petch.

Marasmius cystidiophorus sp.nov.

Pileus 1 cm. latus, tenui-membranaceus, convexiusculus dein expansus, margine striato-sulcatus, cinnamomeus, carne alba; lamellae remotae, latiusculae, sinuato-adnatae, rugis transversus junctae, albidae; stipes corneus, rigidus, tenuis, atro-fuligineus, albo-pruinosus; pelliculae celluli sursum verrucosi; cystidia cylindrica, membrana crassa, 40 × 10–11 μ; sporae ellipsoideae, hyalinae 7–8 × 2·5 μ.

Ad fragmenta dejecta in sylvis, Arena, Trinidad. Dennis 259 Typus.

Pileus up to 1 cm. diameter, convex, then flattened, striate-sulcate at the margin, cinnamon-brown, drying darker; flesh very thin, white below the epidermis. Gills distant, broad, sinuately adnate, connected by irregular veins, white or pale buff. Stipe wiry, very slender, black with a white pruina formed of stiff, hyaline somewhat tapering hairs 30–40 × 5–8 μ. Spores elliptic-cylindric, 7–8 × 2·5 μ, print white, non-amyloid. Surface of the pileus of thin-walled, pear-shaped, hyaline cells 6–10 μ wide bearing short granular processes. Subepidermis formed of several layers of brown-walled cells overlying a trama of interwoven hyaline hyphae. Cystidia scattered over the gill face, conspicuous under a × 10 lens, cylindrical with a moderately thick wall, about 40 × 10–11 μ, coarsely encrusted with a colourless substance. (Pl. 23, fig. 7; Text-fig. 5.)

On sticks in forests. Trinidad, Arena Forest, 30 October 1949, Dennis 259 (Typus).

Dennis 258, on fallen leaves from the same locality and date, has the pileus only 3 mm. wide, hairs of the stipe 28 × 8 μ and the cystidia non-encrusted and only slightly protruding. It is, I believe, a depauperate state of *M. cystidiophorus*.

Marasmius subingratus sp.nov.

Solitaria, graveolens; pileus 8 mm. latus, convexiusculus dein expansus, laevis, sayal-brunneus vel cinnamomeus, carne alba; lamellae confertiusculae, adnatae, albae; stipes tenuis, brunneus deorsum atro-fuligineus, apice albo-pruinosus; sporae ellipsoidae, hyalinae 6–8 × 2·5–3 μ.

Ad fragmenta dejecta in sylvis, Arena, Trinidad. Dennis 137 Typus.

Pileus up to 8 mm. diameter, convex, then flattened, smooth or with minute wrinkles radiating from the disk, sayal-brown to cinnamon; flesh thin, white, smelling strongly of garlic. Gills very crowded, of two lengths, narrow, adnate, white. Stipe slender, less than 1 mm. thick, solid, concolorous with the pileus above, shading to black below, white-pruinose at the apex with thin-walled, ventricose, hyaline hairs about 25 × 8 μ.

Spores hyaline elliptic-cylindric, 6–8 × 2·5–3 μ, non-amyloid. Basidia 12–15 × 3–5 μ. Gill edge fertile. Pileus surface formed of slender, more or less cylindrical hyaline cells, sometimes branched at the tip, about 10 × 1–2 μ. These are borne on a single layer of hyaline hyphae 3 μ wide. Subepidermis of two to three layers of brown-walled hyphae 4–5 μ wide overlying a trama of slender hyaline hyphae. (Pl. 20, fig. 13; Text-fig. 6.)

Solitary on forest litter.

Trinidad: Arena Forest, 5 October 1949, Dennis 137 (Typus); same locality, 30 October 1949, Dennis 137A.

This curious little fungus might well be sought in *Collybia* but its pileus anatomy offers features comparable with *Marasmius cystidiophorus*, and the curious cuticular projections in some ways recall those of cystidia with short processes (Patouillard's 'cystides-en-brosse'). The slender stipe is also like that of a *Marasmius*.

CRINIPELLIS Pat., *J. Bot., Paris*, **3**, 336, 1889

Type species: *Collybia stipitaria* Fr.

Patouillard erected *Crinipellis* for species of *Collybia* in which the pileus was covered with long, tough, thick-walled hairs. The genus has been redefined by Singer (1942), who restricts it to species in which the walls of the pileal hairs turn dark rufous-bay or almost violet in Melzer's reagent. I have here treated it in the older sense as a convenient receptacle for species of *Collybia* or *Marasmius* with long hairs on the pileus. An excellent key to the species recognized by Singer will be found in his monograph cited above. The species collected in Trinidad were:

Pileus red or reddish purple:	
Parasitic on cacao	*C. perniciosus*
On other trees	*C. rubidus*
Pileus grey-brown, densely shaggy	*C. septotricha*
Pileus white or grey, with scattered stiff bristles:	
Pileus very minute, on dead leaves	*C. albocapitatus* var. *occidentalis*
Pileus about 1 cm. diam., on wood or sticks	*C. stenophylloides*

Crinipellis septotricha Singer, *Lilloa*, **8**, 468, 1942

Pileus up to 8 mm. diameter, hemispherical, edge incurved when young, then convex or flattened, clothed with chestnut-brown or bistre hairs sometimes cohering to form pointed squamules; flesh thin, white. Gills rather crowded, adnexed or almost free, white. Stipe cylindrical, flexuous, tomentosely fibrillose with hairs like those of the pileus, up to 1 mm. thick. Spores elliptical, hyaline, with a large and prominent apiculus, often densely granular at the centre and clear at each end, 9–11 × 4–5 μ. Gill edge sterile, formed of hyaline, bottle-shaped cystidia about 20 μ long, 8 μ diam. below and 4 μ at the neck. Hairs of the pileus about 200 × 4–5 μ with thick yellowish brown walls, tapering and paler towards the rounded tip, closely septate especially towards the apex. (Pl. 20, fig. 6, Text-fig. 7.)

Scattered on forest debris.

Baker trace, Arena Forest, Trinidad, 30 October 1949, Dennis 257.

This species is very near the common temperate *C. stipitarius* (Fr.) Pat., from which it differs in its slightly larger spores and septate hairs. Singer described a forma *papillata* with papillate pileus, on trunks, stumps and manufactured wood, and a forma *umbilicata*, flat or umbilicate at the disk, on smaller sticks and twigs. Dennis 257 is the latter form.

Singer (1942) has described about a dozen more species of *Crinipellis* from tropical America many of which should be sought in Trinidad.

Crinipellis perniciosus (Stahel) Singer, *Lilloa*, **8**, 503, 1942

Marasmius perniciosus Stahel, *Dep. Landbouw Surinam Bull.* **33**, 16, September 1915.

Pileus about 1 cm. diameter, convex, margin at first incurved, eugenia-red, shading to Venetian pink at the margin and between the gills, disk flat with a central black dot, minutely hairy when unexpanded, becoming smooth except at the disk; flesh thin, white under the cuticle. Gills distant, adnate to the expanded apex of the stipe, of two lengths, white. Stalk short, white, cylindrical, apex expanding into the pileus, about 1 mm. thick, solid, often curved, base slightly enlarged and white-strigose. Spores elliptical, non-amyloid, 8–10 × 4 μ. Cystidia on gill edge bottle-shaped, 35–50 × 9–14 μ. Surface of the pileus formed by a rather open network of thin-walled hyphae 7–10 μ wide, rather closely septate with conspicuous clamp connexions, their walls encrusted with reddish granules. The black central dot is formed of erect, dark reddish brown setae up to 100 × 7 μ, tapering to a rounded tip. In the young sporophores similar setae occur scattered over the whole surface, erect at the disk, curved and prostrate elsewhere. (Pl. 20, fig. 4.)

Collections seen.—Trinidad: Santa Cruz, 26 October 1949, W. T. Dale, Dennis 237; unlocalized, Stell, 15 April 1929. Cuba: Herb. Berk. as *Marasmius scalpturatus* Berk. & Curt., but apparently unpublished.

As noted by Stahel, the swollen apex of the stipe to which the gills are attached shrinks away from the flesh to form a collar in dried specimens. The fungus or the disease it causes has been recorded also from Bolivia, Peru, Ecuador, Colombia, Venezuela, Brazil, Surinam, British Guiana and Tobago.

Crinipellis stenophylloides sp.nov.

Pileus membranaceus, primo convexus, brunneus, dein explanatus, 1 cm. latus, griseus, pilis aspersus, brunneus, membrana crassa obsessus; lamellae paucae, remotae, adnatae, angustissimae lamellas cantharelli plicaeformes referantes, ramosiusculae et marginem pilei versus venoso-reticulatae, pileo concolores; stipes basi brunneo-fuscus, apice griseus, pruinosus; sporae lanceolatae, hyalinae 15–19 × 3–4 μ; cystidia sparsa, membrana tenui 40 × 14 μ.

Ad fragmenta dejecta in sylvis, St Augustine, Trinidad. Dennis 100A Typus.

Pileus at first hemispherical, light brown, becoming expanded and flattened, light grey, bearing scattered brown setae; flesh thin, soft, non-amyloid, of loosely woven thin-walled hyphae. Gills adnate, distant, narrow or fold-like and often interconnected, light grey. Stipe cylindrical, about 1 mm. thick, purplish brown below, greyish above, minutely downy with thin-walled, hyaline, cylindrical, obtuse hairs up to 70 × 10 μ, sometimes encrusted with amorphous material. Spores non-amyloid, tear-shaped, 15–19 × 3–4(–5) μ, print white. Cystidia scattered, like the hairs of the stipe, about 40 × 14 μ. Setae of the pileus brown, thick-walled, tapering to a rounded tip, up to 140 × 5 μ, stiff and erect. (Text-fig. 8.)

Gregarious on forest debris.

Collections seen: Trinidad, St Augustine, on dead wood, 6 October 1949, Dennis 100 A (Typus); on dead bamboo, River Estate, Diego Martin, 30 September 1949, Dennis 100.

In some ways this fungus recalls *C. mauretanicus* R. Maire, doubtfully identified by Singer (1942) with *C. subtomentosus* (Peck) Singer, both of which have broad gills, much shorter spores and adpressed hairs. *M. stenophyllus* Mont. is superficially similar but I could find no setae on the type at Paris. *C. stenophylloides* should also be compared with *Marasmius candidus* var. *setulosus* Joss. & Smith, *Mycologia*, **33**, 496, 1941.

Crinipellis albocapitatus (Petch) comb.nov., var. **occidentalis** var. nov.

A typo differt sporis majoribus, 12–15 × 3 μ.

Pileus 1–2 mm. diameter, flat or depressed, white with scattered stiff, brown setae; flesh very thin and membranous, white. Gills three to four, adnate, fold-like, white. Stipe cylindrical, wiry, very slender, red-brown, bearing numerous setae. Spores tear-shaped, hyaline, 12–15 × 3 μ. Cuticle of the pileus formed of smooth, thin-walled, cylindrical or pyriform cells, somewhat pointed above, hyaline, 20–25 × 5–9 μ. Setae straight, stiff, tapering, brown with moderately thick walls, up to 450 μ long by 5–7 μ at the base. Cystidia thin-walled, cylindrical, obtuse, hyaline, 25–30 × 8 μ, often secreting a cap of brown gummy material. Basidia clavate, about 20 × 5–6 μ, reddish brown in Melzer's reagent. (Text-fig. 9.)

Scattered on dead leaves in forest litter

Arena Forest, Trinidad, 1 December 1949, Dennis 414 (Typus).

The Trinidad collection agrees in essentials with the type, but Petch found the spores of the latter only 8–10 × 3 μ. *Marasmius minutissimus* Peck is a similarly minute white species on dead leaves, but judging by the description the hairs seem more delicate and hyaline.

Crinipellis rubidus Pat. & Heim, *Ann. Cryptog. exot.* **1**, 272, 1928

Pileus up to 2·5 cm. diameter, convex with a small umbilicus, then flattened and often depressed at the centre, Vandyke-red to Acajou-red, clothed with short suberect hairs, margin undulating and indistinctly striate; flesh thin, vinaceous-buff, thicker and browner at the disk, dark brown in the base of the stipe. Gills rather crowded, of two lengths, adnate, vinaceous-buff with reddish edges. Stipe cylindrical or slightly enlarged upwards, solid, downy, Acajou-red above, darker and browner below. Spores elliptical, 5–7 × 3–4 μ, print pure white, non-amyloid. Surface of the pileus formed of polygonal thick-walled cells, the walls red in Melzer's reagent, covered with undulating, rather thin-walled, distantly septate, suberect hairs, about 300 × 5–6 μ, their walls more or less hyaline, becoming deep red in Melzer's reagent, encrusted with light red granules which dissolve in 10 % KOH solution to give a bluish purple tint. Gill edge formed of cylindrical or irregular and forked, thin-walled, red hairs about 30 × 8 μ forming a palisade. (Pl. 22, fig. 4; Text-fig. 10.)

Gregarious on bark of living trees.

Trinidad: on base of living *Vitex* trunk, path to Maracas waterfall, 25 November 1949, Dennis 376.

Marasmius vinosus Speg. from Tucuman is quite different. It is a true *Crinipellis* with thick-walled, obtuse, cuticular hairs, and is perhaps the same as the earlier *C. eggersii* Pat. from Ecuador, the type of which I have not seen. *Collybia coracicolor* seems closely allied in structure, spores and gill edge but lacks the free hairs on the pileus. No. 422 has a similar gill edge.

CHAETOCALATHUS Singer, *Lilloa*, **8**, 515, 1942

This is a small genus of sessile agarics formerly placed in *Marasmius* or *Pleurotus*. The pileus is shaggy with thick-walled, pseudo-amyloid hairs like those of *Crinipellis*.

Chaetocalathus liliputianus (Mont.) Singer, *Lilloa*, **8**, 527, 1943

Agaricus liliputianus Mont., *Ann. Sci. Nat.* (*Bot.*), Ser. 4, **1**, 99, 1854.
Marasmius nidulus Berk. & Curt., *J. linn. Soc.* (*Bot.*), **10**, 299, 1868.
Pleurotus liliputianus (Mont.) Sacc., *Syll. Fung.* **5**, 385, 1887.
Crinipellis nitidulus Pat. *J. Bot., Lond.*, **3**, 336, 1889.
Pleurotopsis liliputianus (Mont.) Murr., *N. Amer. Flora*, **9**, 293, 1915.

Pileus 2–5 mm. diameter, cup-shaped, resupinate, membranous, sulcate at the margin, very hairy, pure white; flesh very thin, white. Gills distant, broad, free, of two lengths, white. Spores broadly elliptical with oily contents, 8–10 × 5·5–6·5 μ, non-amyloid, print white. Hairs of the pileus thick-walled, hyaline, undulating, septate, about 4–5 μ wide, the walls red-amyloid. Gill edge bearing fusoid cystidia about 25 × 10 μ, sometimes also sparse outgrowing hyphae with clamp connexions. Similar cells occur among the hairs on the pileus. (Text-fig. 11.)

In swarms on dead branches.

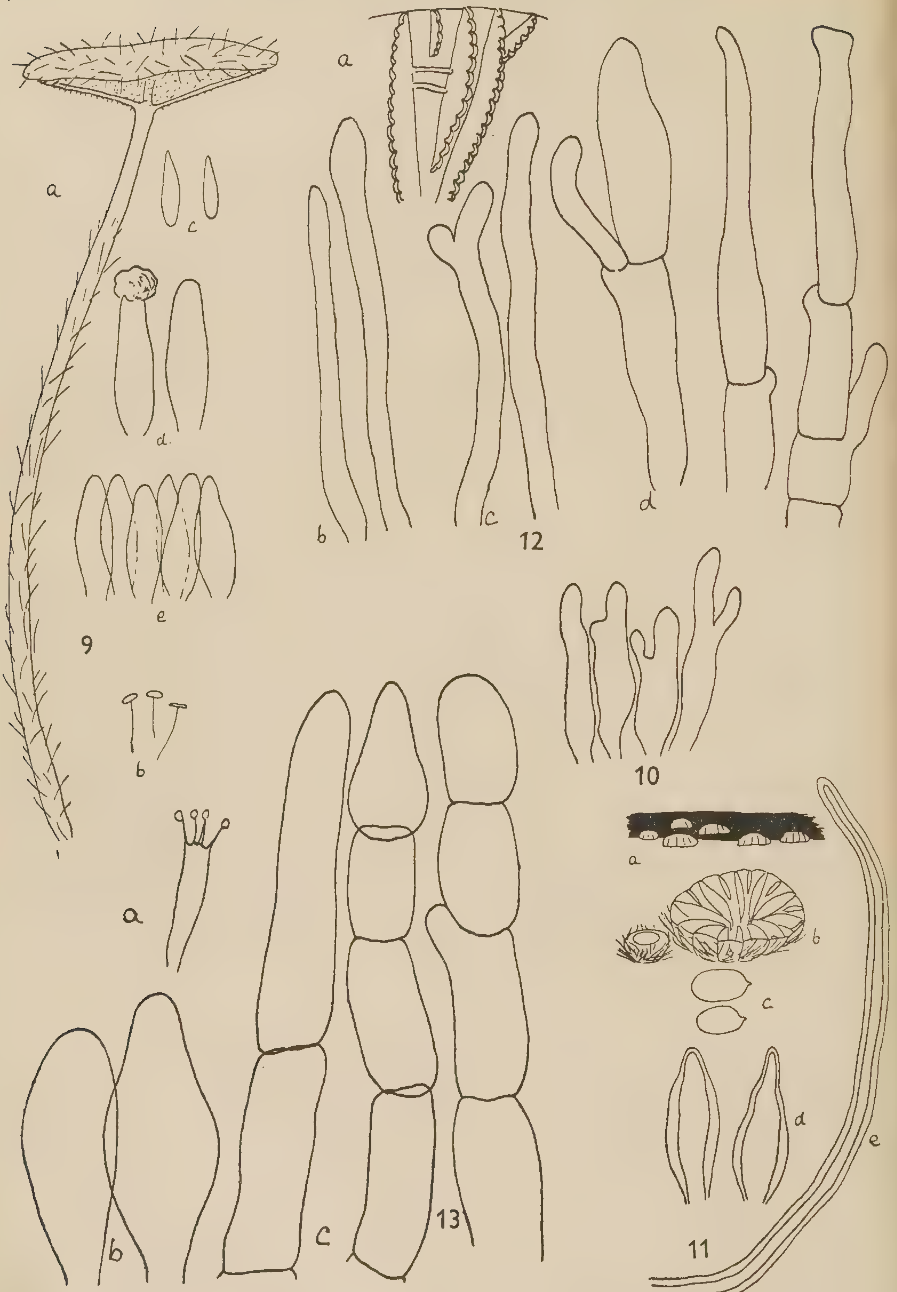
Collections seen.—Trinidad: River Estate, Diego Martin, 27 October 1949, Dennis 58A. Cuba: Wright 78 (Typus of *M. nidulus*).

Singer cites as a synonym also *Crinipellis calosporus* Pat. and collections from Guadeloupe and Ecuador. *Chaetocalathus niduliformis* (Murr.) Singer = *Pleurotopsis niduliformis* Murr. on *Juniperus* in Bermuda seems to differ only in the cystidia which are mostly forked.

COLLYBIA (Fr.) Kummer, *Führer Pilzk.* pp. 26 and 113, 1871

Type species: *Agaricus tuberosus* Bull. ex. Fr.

As here conceived *Collybia* differs from *Marasmius* in its lack of well-developed cystidia with short processes on the surface of the pileus and from *Mycena* in its tougher, non-putrescent character, with a tendency for the pileus margin to be incurved when young. The spores are non-amyloid except in the subgenus *Baeospora*.



Text-fig. 9. *Crinipellis albocapitatus* var. *occidentalis:* (*a*) sporophore, × 20; (*b*) sporophores, × 1; (*c*) spores, (*d*) cystidia, (*e*) section of pileus cuticle, all × 660.

Text-fig. 10. *C. rubidus:* hairs of the gill edge, × 660.

Text-fig. 11. *Chaetocalathus liliputianus:* (*a*) sporophores, natural size; (*b*) sporophores, × 5; (*c*) spores, (*d*) cystidia, (*e*) hair of pileus, all × 660.

Text-fig. 12. *Collybia pilosa* var. *denticulata:* (*a*) marginal portion of several gills, × 10, showing the denticulate edges; (*b–d*) hairs of stipe, gill edge and pileus surface respectively, all × 660.

Text-fig. 13. *C. cinnamomea:* (*a*) basidium, (*b*) hairs of the gill edge, (*c*) hairs of pileus, × 660.

I. Spores non-amyloid:

- A. Pileus cuticle hymeniform, tramal hyphae red-amyloid:
  - *a.* Gills not interveined. *C. nivea*
  - *b.* Gills profusely interveined. *C. nivea* var. *cohortalis*

- B. Pileus cuticle a pile of thin-walled, suberect hairs:
  - *a.* Pileus olive-brown. *C. pilosa*
  - *b.* Pileus cinnamon-brown. *C. cinnamomea*

- C. Pileus cuticle formed of prostrate hyphae, parallel and radiating or interwoven:
  - *a.* Cuticular hyphae encrusted with brown granules:
    - 1. Stipe light brown *C. coracicolor*
    - 2. Stipe blackish brown. *C. johnstoni*
  - *b.* Cuticular hyphae non-encrusted:
    - 1. White species, or with pale buff tints at the disk only (if stipe blackish see *C. omphalodes* below):
      - α. With gloeocystidia in the hymenium and capitate marginal hairs:
        - * Spores 7–9 × 5 μ. *C. cycadicola*
        - ** Spores 11–14 × 4–5 μ. *C. naranjana*
      - β. Without cystidia on the gill face, marginal cystidia hair-like or absent. Spores narrowly elliptical, up to 3 μ wide, or long and tear-shaped:
        - * Pileus less than 1 cm. diameter. *C. dealbata*
        - ** Pileus up to 3 cm.:
          - † Spores small, elliptical. *C. pseudoboryana*
          - †† Spores long and tear-shaped:
            - ‡ No cystidia. *C. cubensis*
            - ‡‡ Cystidia long and cylindrical. *C. longicystis*
      - γ. Cystidia of the gill edge clavate, with obtuse apical processes, spores broadly elliptical:
        - * Pileus exceeding 5 mm. diameter, habit subcaespitose:
          - † Stipe solid. *C. semi-usta*
          - †† Stipe hollow, growing on palms. *C. troyana*
        - ** Pileus up to 5 mm. diameter, sporophores scattered. *C. nana*

    - 2. Pileus purple:
      - α. Gill edge fertile, spores 4–6 × 3 μ. *C. sericipes*
      - β. Gill edge sterile, cystidia with apical process, spores longer:
        - * Pileus striate, stipe hollow. *C. troyana*
        - ** Pileus not striate, stipe solid. *C. purpurea*

    - 3. Pileus or gills bright yellow, spores small, subglobose, gills reddening when dried:
      - α. Pileus bright yellow, up to 3 cm., spores 3–5 × 3–4 μ. *C. colorea*
      - β. Pileus clay-colour, up to 1·5 cm., spores 3–5 × 2–3 μ. *C. luteo-olivacea*

    - 4. Pileus some shade of brown or yellowish, white in *C. omphalodes*, spores elliptical or tear-shaped:
      - α. Prominent cystidia on the gill face:
        - * Cystidia thick-walled, pileus dark-brown and conical. *C. mycenoides*
        - ** Cystidia thin-walled:
          - † Pileus velvety, buff. *C. anthracophila*
          - †† Pileus smooth, clay-coloured or brown:
            - ‡ Pileus small, acutely umbonate. *C. brunneo-umbonata*
            - ‡‡ Pileus large, hygrophanous, umbilicate. *C. cavipes*
          - ††† Pileus whitish, stipe wiry. *C. omphalodes*

β. No cystidia on the gill face:
*Stipe slender and wiry:
† Stipe covered with brown setae. *C. brunneo-setosa*
†† Stipe covered with hyaline downy hairs:
‡ Stipe brown:
§ Pileus buff to ochraceous-tawny. *C. hirtella*
§§ Pileus wood-brown. *C. subcoracina*
‡‡ Stipe light yellow. *C. setulosipes*
** Stipe thicker and cartilaginous to fleshy:
† Stipe solid:
‡ Pileus downy, up to 2 cm. diameter. *C. trinitatis*
‡‡ Pileus smooth or fibrillose, larger:
§ Pileus surface of woven hyphae, margin incurved. *C. subpruinosa*
§§ Pileus surface of radiating hyphae, margin expanded. *C. subfumosa*
†† Stipe hollow:
‡ Pileus large, thin, whitish at the margin, striate. *C. polygramma*
‡‡ Pileus less than 3 cm. diameter:
§ Margin striate:
‖ Ochraceous tawny and closely striate. *C. hemileuca*
‖‖ Paler with more distant striae. *C. brasiliensis*
§§ Pileus not striate:
‖ Cartridge buff to wood-brown. *C. fibrosipes*
‖‖ Similar but streaked with ochraceous-tawny radiating fibrils. *C. fibrosipes* var. *harrisii*
‖‖‖ Russet or fawn with a yellow stipe. *C. dryophila*

II. Spores blue-amyloid, broadly elliptical (subgenus *Baeospora* Singer)
A. Pileus with a minute dark umbo. *C. erinensis*
B. Pileus not umbonate. *C. pleurotoides*

An attempt has been made below to arrange the species in ten groups, labelled A to K, which do not follow exactly the order in the above key.

A. *Globularinae* Kühner, *Botaniste*, **25**, 100, 1933

Pileus cuticle hymeniform, tramal hyphae strongly red-amyloid

Collybia nivea (Mont.) comb.nov.

Marasmius nivea Mont., *Ann. Sci. Nat.* (*Bot.*), Ser. 4. **1**, 117, 1854.

Pileus up to 5 cm. diameter, convex, with a shallow umbilicus, then flattened and undulating at the margin, striate, cream-coloured, darker at the disk; flesh thin, tough and elastic, cream-coloured. Gills narrow, distant, of two to three lengths, sometimes irregularly forked, adnate, concolorous. Stipe cylindrical, flexuous, hollow, smooth, purplish brown below, cream-coloured at the apex. Spores tear-shaped, hyaline, 8–11 × 2·5–3 μ. Surface of the pileus formed of smooth, subglobose, thin-walled cells 14–20 μ diameter. Cystidia wanting. Tramal and cuticular hyphae deeply red-amyloid in Melzer's reagent. (Pl. 20, fig. 1.)

Gregarious on dead sticks.

Collections seen.—French Guiana: Leprieur 1038 (Herb. Montagne, Paris). Trinidad: Arena Forest, 30 October 1949, Dennis 265; Maracas Waterfall, 25 November 1949, Dennis 265C. Venezuela: Rio Chacaito, Caracas, 18 November 1949, Dennis 265B.

Collybia hymenocephala Speg. 1883 is a probable synonym, and *Marasmius tortipes* Berk. & Curt. is an allied species.

var. **cohortalis** (Berk.) comb.nov.

Marasmius cohortalis Berk., *Vidensk. Medd. naturh. Foren. Kbh.* p. 34, 1879.

Differs from the type in being caespitose with strongly interveined gills and apparently somewhat smaller spores 5–7 × 2–3 μ. (Pl. 20, fig. 2.)

Caespitose in dense clusters arising from a common white mycelial mat on plantation litter.

Collections seen.—Trinidad: St Augustine, 3 December 1949, Dennis 18. Brazil: Glaziou 9171.

I do not think this terrestrial form with interveined gills can be maintained as a distinct species. Some specimens of *Collybia nivea* have the gills clearly interveined, especially towards the stipe, and it appears to me that this is a character of very little value in tropical agarics. Judging by Oersted's drawing, *Marasmius glebigenus* Fr. 1851, may be this fungus. If so it antedates *M. nivea*, but I do not feel justified in taking up the name unless the cuticular structure can be checked in the type specimens. These were sent in spirit to Copenhagen and cannot now be traced there.

B. *Pileus surface covered with thin-walled septate hairs*

Collybia pilosa sp.nov.

Gregarius; pileus 3·5 cm. latus, convexus dein expansus, olivaceus vel brunneus, tomentosus dein rimoso-squamulosus, tenuis, lentus, in sicco subpellucidus; lamellae remotae, adnatae, rugis transversis junctae, albae; stipes tenuis, tenax, fistulosus, laevis, sordide olivaceus vel ater, apice albidus; sporae ellipticae, hyalinae 11–13 × 5–5·5 μ.
Ad terram in sylvis, St Joseph, Trinidad. Dennis 315A Typus.

Pileus up to 3·5 cm. diameter, convex, then flattened, olive-brown to sayal-brown, tomentose, cracking into matted squamules exposing the buff flesh; flesh thin, tough, translucent when dried. Gills distant, adnate, of two lengths, the shorter often zigzagging, closely interconnected by a network of veins, white, then pale buff. Stipe cylindrical about 2 mm. wide, wiry, hollow, smooth, white above, olive-brown to black below. Spores elliptical, hyaline, 11–13 × 5–5·5 μ, white in the mass, non-amyloid. Hairs of the pileus thin-walled, septate with clamp connexions, about 140 × 14–20 μ wide, entangled, contents reddish brown, dark brown when dried. Cystidia wanting. Trama non-amyloid. (Pl. 22, fig. 2.)

In swarms on the ground in plantations.

Trinidad: on the ground under bamboos, St Joseph, 10 November 1949, Dennis 315A (Typus); amongst roots of *Ficus benjamina*, Botanic Garden, Port of Spain, 9 November 1949, Dennis 315. Venezuela: Rio Chacaito in scrubby forest, 18 November 1949, Dennis 315V.

Some of the tramal hyphae appear to have slightly gelatinized walls so that the species may be allied to *Micromphale*. *Collybia pilosa* is apparently the West Indian representative of *C. leucophaea* (Berk. & Br.) Sacc. which, according to Petch (1947), has spores only 6–10 × 3–4 μ.

var. **denticulata** var.nov.

A typo differt lamellis sinuatis, acie denticulatis; stipes velutinus.
Ad terram in sylvis, St Joseph, Trinidad. Dennis 317 Typus.

Differs from the type in the sterile gill edge, formed of long undulating hyaline hairs which cohere in dried material to give a strongly denticulate margin to the gill, and in the stipe being velvety with similar hairs. The gills are sinuate and less interveined than in the type. (Text-fig. 12.)

Despite these differences the characteristic spores common to 315 and 317, and the similar hairs on the pileus, make me unwilling to recognize two species here, especially as Dennis 315A and 317 occurred at the same time in the same bamboo plantation at St Joseph.

St Joseph, Trinidad, 10 November 1949, Dennis 317 (Typus).

Collybia cinnamomea sp.nov.

Subcaespitosus; pileus 4 cm. latus, expansus, centro plus minusve umbilicatus, tenuis, margine flexuosus, velutinus, cinnamomeus; lamellae confertae, adnatae vel postice attenuatae, bubalinae, in sicco pruinosae; stipes cylindricus, fistulosus, fibrillosus, cinnamomeus; sporae ellipticae, hyalinae 5–7 × 3–4μ; cystidia ventricosa, hyalina 50–60 × 20–25μ.

Ad lignum in sylvis, Arena, Trinidad. Dennis 256 Typus.

Pileus up to 4 cm. diameter, flattened, depressed at the disk, margin undulating, surface minutely velvety, cinnamon coloured, shading to tawny at the centre, flesh thin, soft, concolorous. Gills rather crowded, of three lengths, adnate or slightly narrowed at each end, light ochraceous-buff, minutely downy with the cystidia when dry. Stipe equal, 3–4 mm. thick, smooth, fibrous, hollow, concolorous with the pileus. Spores broadly elliptical, 5–7 × 3–4 μ, print white, non-amyloid. Basidia 4-spored with long sterigmata, about 25 × 5 μ. Pileus surface covered with a close pile of short two to four-celled hairs about 100 × 8–15 μ, their walls thin and light brown. Tramal hyphae similar but 4–6 μ wide, arranged approximately parallel in the gills. Cystidia on the gill edge hyaline, thin-walled, bladder-shaped or ventricose 50–60 × 20–25 μ, similar on the gill face. (Pl. 23, fig. 15; Text-fig. 13.)

Subcaespitose on stumps.

Trinidad, Arena Forest, 30 October 1949, Dennis 256 (Typus).

C. *Species with encrusted brown surface hyphae*

Collybia coracicolor (Berk. & Curt.) comb.nov.

Marasmius coracicolor Berk. & Curt., *J. linn. Soc.* (*Bot.*), **10**, 294, 1869.

Pileus 1–2·5 cm., convex, then flattened or depressed at the disk, Sanford's Brown striate, smooth; flesh concolorous, thin hygrophanous. Gills distant, adnate, of three lengths, concolorous with a paler margin. Stipe short, cylindrical or enlarged upwards, hollow, concolorous, covered with minute white down, composed of cylindrical obtuse hyaline thin-walled hairs about 85 × 11 μ. Surface of the pileus of more or less radiating hyphae 5–12 μ wide, their walls encrusted with brownish granules. Gill edge formed of closely packed cylindrical or irregularly lobed thin-walled hyaline hairs about 70 × 8–10 μ. Spore print white, non-amyloid, spores 6–8 × 4 μ. Tramal hyphae loosely woven, not at all gelatinized, feebly reddened in Melzer's reagent. (Pl. 22, fig. 3; Text-fig. 14.)

In swarms on dead wood in montane forests.

Trinidad, on dead lianes, Morne Bleu, 4 December 1949, Dennis 420.

M. curtipes Mont. is superficially similar, but the very mouldy type seems to have a different cuticle and I cannot trace in it the sterile gill edge.

Collybia johnstoni (Murrill) comb.nov.

Marasmius johnstoni Murrill, *N. Amer. Flora*, **9**, 269, 1915.

Pileus 1–3 cm. diameter, olive-brown to sayal-brown, drying dark purplish brown, sulcate-striate, convex then expanded with a small, shallow umbilicus; flesh thin, whitish to pale brownish drab. Gills moderately spaced, of three lengths, adnate, often once forked or the shorter fused with the longer, buff. Stipe slender, equal or slightly enlarged at the apex, 1–2 mm. thick, hollow, dark vinaceous-brown to almost black with a white pruina formed of hyaline, thin-walled, cylindrical hairs, 30–80 × 4–8 μ, often once or twice forked near the tip, obtuse. Spores elliptical, non-amyloid, 5–9 × 3–3·5 μ. No cystidia on the gill face, gill edge sterile with cylindrical or undulating hyaline hairs about 20–30 × 4 μ. Surface of the pileus formed of interwoven hyphae 5–6 μ wide, encrusted with brown granules, sometimes with small nodular hyaline protuberances on their upper surface. Tramal hyphae similar but hyaline and non-encrusted. (Pl. 22, fig. 9; Text-fig. 15; and see Pl. 21, fig. 9.)

On forest litter and herbaceous stems.

Collections seen.—Puerto Rico: Rio Piedras, J. R. Johnston, 25 May 1913, on leaves (Typus). Trinidad: Arena Forest, 5 October 1949, Dennis 134, on herbaceous stems (Pl. 4, fig. 9; Text-fig. 15). Venezuela: Rancho Grande, Maracay, 19 November 1949, Dennis 341 (Pl. 3, fig. 9).

Dennis 341 is much larger and has a lighter coloured pileus than 134, but the two appear to agree in essential characters, and I feel many more collections are required before one can attempt to separate them specifically. The type is a small form like 134.

D. *Lactocollybia* Singer, as genus in *Schweiz. Z. Pilzkunde*, **12**, 71, 1939

Species with gloeocystidia

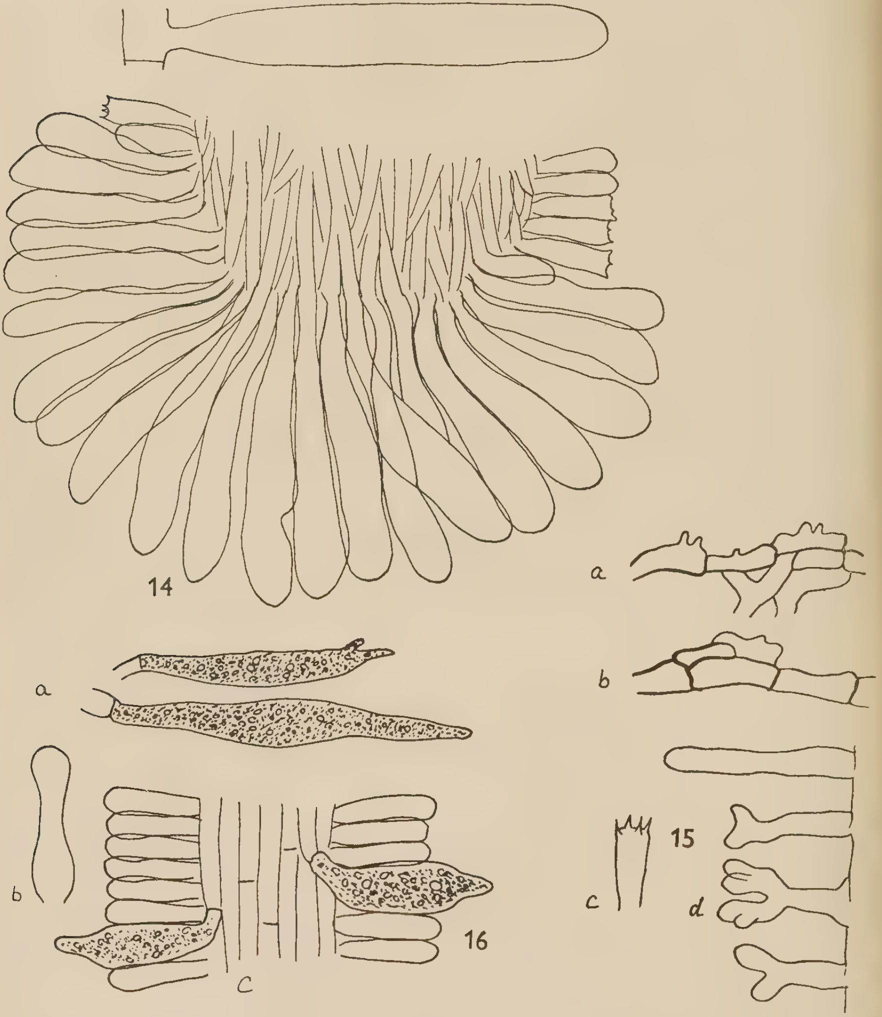
Collybia cycadicola Josserand, *Bull. Soc. mycol. Fr.* **51**, 246, 1935

Pileus up to 5 cm. wide, convex with a flattened top or becoming flattened and slightly depressed at the disk, smooth, pure white or cream coloured; flesh thin, white. Gills crowded, of three lengths, adnate, narrow, thin, white. Stipe smooth, hollow, equal, 2–5 mm. thick, rather brittle, white or cream coloured. Spores pip-shaped, 7–9 × 5 μ, print white, non-amyloid. Pileus surface formed of matted hyphae 5 μ wide, trama of similar interwoven hyphae, becoming parallel in the gills. Scattered through the trama are elongated fusiform cells up to about 160 × 8 μ, crowded with small oil globules. These tend to emerge in the hymenium of the gill face as short, pointed, ventricose gloeocystidia about 30–40 × 8–10 μ. Gill edge fringed with cylindric-clavate hyaline hairs about 30 × 8–10 μ. (Pl. 21, fig. 7; Text-fig. 16.)

Gregarious on dead wood.

Trinidad: St Augustine, 1 October 1949, Dennis 104, on rotting wood; same locality, 29 October 1949, Dennis 104A; River Estate, Diego Martin, 22 September 1949, at base of *Swietenia* trunk, Dennis 27.

M. Josserand has kindly examined material of Dennis 104, and agrees that it is 'espèce sûrement très proche de la mienne, probablement spécifiquement indentique'. *Collybia nivosula* Berk. & Curt. is superficially very similar, but Wright's specimen from Cuba, on which the name was founded is accompanied by the note 'gills free—stipe solid'. It is in very poor condition and covered with moulds. This name seems to have been first published by Cooke (1892), with a description drawn up from both the Cuban and a Victorian collection, and is of very doubtful status on that account.



Text-fig. 14. *Collybia coracicolor:* above, hair of stipe, below, section of gill edge, × 660.
Text-fig. 15. *C. johnstoni:* (*a*), (*b*) sections of pileus cuticle, (*c*) basidium, (*d*) hairs of the stipe, all × 660.
Text-fig. 16. *C. cycadicola:* (*a*) lactifers from pileus cuticle, (*b*) hair of gill edge, (*c*) section of gill, all × 660.

Collybia naranjana sp.nov.

Gregarius; pileus 3 cm. latus, convexus dein expansus, tenuis, albus, glaber, subviscidus, argine pellucido-striatus; lamellae confertissimae, adnexae, acie integerrimae, albae; ipes incurvus, cylindricus, fistulosus, albus, laevis; sporae ellipsoidae 11–14 × 4–5 μ, yalinae; pleurocystidia ventricosa, 20–30 × 7–11 μ, cheilocystidia cylindrico-clavata μ diam.

Ad corticem truncorum putrescentium in sylvis, Naranja, Trinidad. Dennis 118 Typus.

Pileus up to 3 cm. diameter, convex, becoming flattened, white, cream with age, pellucidly and closely striate at the margin when moist, surface mooth and slippery; flesh thin, white. Gills very crowded, of three lengths, dnexed, edge even, white. Stipe equal, curved, smooth, often becoming xcentric, hollow, 1–2 mm. thick, white. Spores pip-shaped, non-amyloid, 3–) 11–14 × (3·5–) 4–5 μ. Basidia 4-spored, about 18 × 6 μ. Surface of the ileus formed of slender matted hyphae embedded in a gelatinous matrix, nderlying trama of loosely woven hyphae about 14 μ wide. Cystidia of he gill face numerous, thin walled, ventricose, 20–30 × 7–11 μ with a short eak about 2–5 μ wide, scarcely protruding. Gill edge of cylindric-clavate airs about 11 μ wide at the base and 8 μ at the tip. (Text-fig. 17.)

In swarms on rotten logs in montane forest. Trinidad, Tucuche trail on Naranja, *c.* 2000 ft., 2 October 1949, Dennis 118 (Typus).

This seems closely allied to *C. cycadicola* differing in the pileus surface and arger spores. *Heliomyces decolorans* Berk. & Curt. is structurally similar but as slightly interveined gills and longer cystidia. *Collybia boryana* (Berk. & Mont.) Sacc., superficially similar, has a completely gelatinized trama, maller basidia and no cystidia.

E. *Fleshy species with prominent cylindrical cystidia on the gill face* (see also Collybia omphalodes)

Collybia mycenoides sp.nov.

Pileus conico-campanulatus, 1·5 cm. latus, tenuis, umbrinus, fibrillosus, carne alba; amellae confertae, liberae, albae, pruinosae; stipes cylindricus, fistulosus, laevis, albus eorsum flavus; sporae ellipsoidae, guttulatae, 5–7 × 4–5 μ, hyalinae; cystidia ventricosa 5–60 × 13–20 μ, membrana crassa.

Ad terram in sylvis, Siparia, Trinidad. Dennis 271 Typus.

Pileus conico-campanulate, about 1·5 cm. broad, raw-umber, the cuticle formed of radiating hyphae visible as fibrils under a lens, not striate; flesh thin, white under the cuticle, with a grey line at the base of the gills, pale yellow in the base of the stipe. Gills crowded, of three lengths, free, white, pruinose under a lens because of the cystidia, especially when dried. Stipe equal, smooth, hollow, about 2 mm. thick, white above, very pale yellow below. Spores ellipsoid with a somewhat lateral apiculus, often guttulate, 5–7 × 4–5 μ, print white, non-amyloid. Cystidia of the gill face ventricose, mostly thick-walled except at the obtuse tip, 45–60 × 13–20 μ, those of the gill edge similar but often smaller and thinner walled. Cuticular hyphae broad, thin-walled, with brown sap. (Pl. 22, fig. 14; Text-fig. 18.)

Solitary on the ground in forests.

Trinidad, Siparia, 3 September 1949, Dennis 271 (Typus); Morne Bleu, 4 December 1949, Dennis 271 A.

This species might be sought in *Mycena*. Dr A. Smith informs me that of the species in North America this most nearly resembles *M. floccipes* (Fr.) Kühner, but differs from it and from *M. pseudotenax* Smith in the thick-walled cystidia on the gill face. *M. floccipes* was referred to *Collybia* by Fries. The type of *Marasmius hinnuleiformis* is very near *Collybia mycenoides* but its pileus has dried much paler. Also it came from a very different habitat, on *Quercus* cupules at 5000 ft. in Mexico.

Collybia brunneoumbonata sp.nov.

Pileus 1·5–2·5 cm. latus, hemisphaericus vel campanulatus, tenuis, argillaceus, umbone acuto, carne umbrina; lamellae subconfertae, adnatae vel denticulo subdecurrentes, albae; stipes cylindricus, fistulosus, albus deorsum bubalinus, pruinosus; sporae ellipsoideae, guttulatae 6–8 × 4–4·5 μ; cystidia cylindrica, hyalina 50–60 × 7–9 μ.

Ad terram in sylvis, Erin, Trinidad. Dennis 312 Typus.

Pileus 1·5–2·5 cm. diameter, hemispherical to campanulate with a prominent acute umbo, clay-colour; flesh thin, appearing raw-umber in the pileus, white in the stipe. Gills broad or narrow, moderately spaced, of three lengths, adnate with a small decurrent tooth, white, Stipe cylindrical or slightly attenuated upwards, hollow, pale buff below, white above, pruinose with clusters of short, white, thin-walled, cylindrical, obtuse hairs about 30 × 6 μ. Spores ellipsoidal, with a large central guttule, 6–8 × 4–4·5 μ, print white, non-amyloid. Gill edge fringed with thin-walled, cylindrical, obtuse hyaline hairs, 50–60 × 7–9 μ, with oily contents; similar cystidia occur on the gill face and cuticle of the pileus. Surface of the pileus formed of parallel, hyaline hyphae overlying a dark brown subcuticular layer. Trama of thin-walled hyaline hyphae, reddish brown in Melzer's reagent. (Pl. 22, fig. 1; Text-fig. 19.)

Solitary on the ground in forests.

Trinidad, Erin, 6 November 1949, Dennis 312 (Typus). Jamaica: Markham Hill, Cinchona, Blue Mountains, 25 December 1949, Dennis J66.

Collybia cavipes Pat. & Gaill., *Bull. Soc. mycol. Fr.* **4**, 14, 1888

Pileus up to 7 cm. diameter, hygrophanous, convex and umbilicate, margin at first inrolled, smooth, olive-brown becoming buffy brown, striate; flesh thin, grey, watery. Gills rather close, of three lengths, broad adnate, light grey to buff. Stipe equal, 4–5 mm. thick, smooth, hollow, light grey to buffy brown. Spores elliptical about 6 × 4 μ, possibly feebly amyloid. Gill face and edge thickly studded with thin-walled, cylindrical hyaline cystidia easily seen under a × 10 lens, up to 80 × 14 μ. Surface of the pileus formed of approximately parallel hyphae 11–17 μ wide, with brown contents. (Pl. 21, fig. 1.)

Occurs singly on rotten logs.

Trinidad: About 2000 ft. on Cerro del Aripo, 23 October 1949, Dennis 235; roadside forest, north of Erin, 6 November 1949, Dennis 235B; Siparia forest reserve, 5 November 1949, Dennis 235A.

Of *C. lacera* (Lasch) Berk., Smith & Hesler (1940) wrote: 'Very frequently the gills of this species are infected with a parasite, the sporophores of which when immature simulate long narrow cystidia 60–80 × 8–10 μ. Their true nature can usually be determined, however, because their apices become differentiated into sporangia.' No sporangia were observed on the gills of *C. cavipes*. All specimens seen carried similar cystidia, and I see no reason to believe them foreign to the Agaric.

Collybia anthracophila sp.nov.

Gregarius; pileus 3 cm. latus, hemisphaericus, margine incurvus, dein convexus, centro plus minusve umbilicatus, tenuis, pruinosus, sordide bubalinus; lamellae confertissimae, sinuatae vel adnatae, citrinae; stipes fistulosus, fibrillosus, bubalinus deorsum albescens; sporae ellipticae, hyalinae 5–6 × 3·5–4 μ; pleurocystidia 85 × 20 μ.
In culmis carbonaceis bambusae, St Joseph, Trinidad. Dennis 83 Typus.

Pileus up to 3 cm. diameter, hemispherical with incurved margin, then convex, often depressed at the disk, minutely velvety, deep colonial-buff shading to snuff-brown at the disk; flesh thin, concolorous. Gills very crowded, narrow, of three lengths, sinuate to adnate, pale lemon-yellow. Stipe concolorous with the margin of the pileus or paler, white at the base, fibrous, hollow, up to 6 mm. thick. Spores elliptical, 5–6 × 3·5–4 μ, print white, non-amyloid. Basidia 4-spored. Cystidia abundant on the gill face, cylindric-fusiform, obtuse, about 85 × 20 μ, apex about 14 μ, those of the gill edge smaller, about 40 × 12 μ. Surface of the pileus formed of matted hyphae 5–6 μ wide, with clamp connexions, their terminal cells inflated to about 50–60 × 14 μ and upcurved, giving the velvety aspect to the surface under a lens. (Pl. 20, fig. 7; Text-fig. 20.)

Gregarious on burnt bamboo stools.

Trinidad, St Joseph, 27 September 1949, Dennis 83 (Typus).

F. *Species bright yellow wholly or in part and with minute subglobose spores*

Colybia colorea (Peck) Sacc., *Syll. Fung.* **5**, 230, 1887

Agaricus coloreus Peck., 20*th Annual Report New York State Museum*, p. 54, 1874.

Pileus up to 3 cm. across, convex, then depressed at the centre, amber-yellow, margin incurved, minutely fibrillose; flesh thin, concolorous. Gills crowded, narrow, of three lengths, sinuate to adnexed, concolorous, drying dark red. Stipe cylindrical or slightly attenuated upwards, slender, flexible, hollow. Spores subglobose, hyaline, non-amyloid 3–5 × 3–4 μ, print white. Gill edge sterile, formed of inflated thin-walled hairs about 70 × 8–11 μ. Pileus surface of thin-walled hyphae 8–16 μ wide, with clamp connexions, their terminal cells sometimes inflated to 20 μ. No cystidia on the gill face, trama non-amyloid. (Pl. 21, fig. 3; Text-fig. 21.)

Densely caespitose on dead wood.

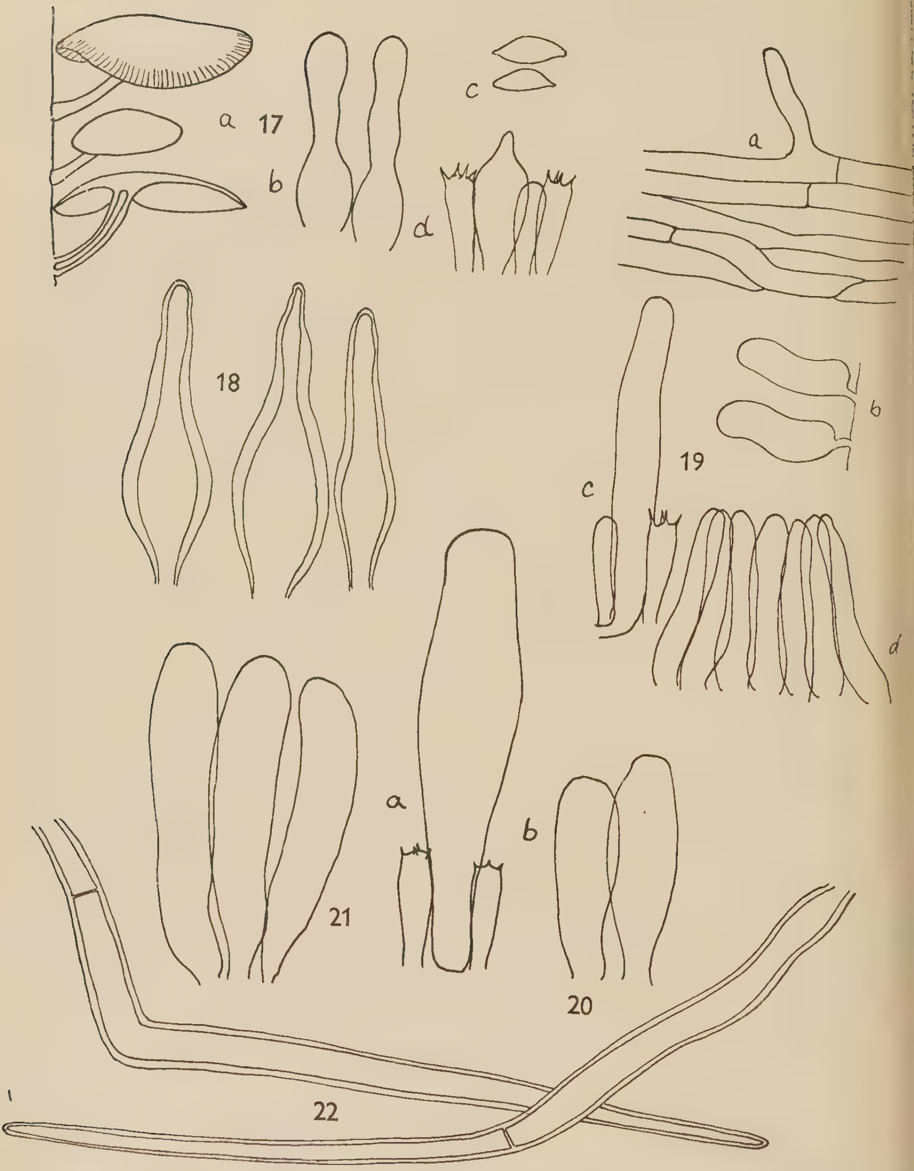
Trinidad; Botanic Garden, Port of Spain, 25 November 1949, Dennis 373.

I doubt the identity of this species with *C. exsculpta* Fr., which Fries compared with *C. dryophila*.

Collybia luteo-olivacea (Berk. & Curt.) Sacc., *Syll. Fung.* **5**, 215, 1887

Agaricus luteo-olivaceus Berk. & Curt., *Ann. Mag. nat. Hist.* (3), **4**, 286, 1859.

Pileus up to 1·3 cm. diameter, convex, clay-colour, surface fibrous, of radiating hyphae; flesh whitish, thin, with a dark line at the base of the gills. Gills crowded, narrow, of two lengths, sinuate, sulphur-yellow,



Text-fig. 17. *Collybia naranjana:* (*a*) sporophores, natural size, (*b*) hairs of gill edge, (*c*) spores, (*d*) pleurocystidium and basidia, all × 660.

Text-fig. 18. *C. mycenoides:* pleurocystidia, × 660.

Text-fig. 19. *C. brunneoumbonata:* (*a*) section of pileus cuticle, (*b*) hairs of stipe, (*c*) pleurocystidium, (*d*) marginal hairs from gill, all × 660.

Text-fig. 20. *C. anthracophila:* (*a*) pleurocystidia, (*b*) cheilocystidia, × 660.

Text-fig. 21. *C. colorea:* cheilocystidia, × 660.

Text-fig. 22. *C. brunneosetosa*, hairs of the stipe, × 660.

ying dark red with pale margins. Stipe concolorous with the pileus, out 2 mm. thick, minutely fibrous with loose hyphae $3\,\mu$ wide, arising om a sulphur-yellow mycelium. Spores hyaline, elliptical $3-5 \times 2-3\,\mu$, ttulate. Cuticular hyphae of the pileus about $5\,\mu$ wide. (Pl. 20, fig. 11.)

Gregarious on rotting logs.

Trinidad, 11 October 1949, Dennis 163.

Gymnopus densifolius Murrill has similar spores, but the dried gills of the pe are yellow, not dark red as in Dennis 163.

G. *Species with cuticle of parallel or interwoven hyphae, no well-developed cystidia (except* Marasmius omphalodes*) and more or less elliptical non-amyloid spores*

α. *Stipe slender, dark coloured and downy*

* *Hairs of the stipe stiff, brown and pointed*

ollybia brunneosetosa sp.nov.

Pileus 3 cm. latus, tenuis, convexus, centro depressus, glaber, sulcato-striatus, succineo-unneus, carne brunnea; lamellae confertae, adnatae, ochraceo-fulvae; stipes corneus, r, deorsum attenuatis, velutinus, pilis rigidis brunneis vestitis; sporae ellipticae, alinae $6-8 \times 2{\cdot}5-3\,\mu$.

Ad ramenta putrida in sylvis. Cerro del Aripo, Trinidad. Dennis 221 Typus.

Pileus up to 3 cm. diameter, convex, slightly depressed at the disk, eply sulcate-striate, smooth, amber-brown; flesh very thin, brown in the leus, white below the black surface of the stipe. Gills adnate, rather rrow, crowded, of three lengths, ochraceous-tawny. Stipe black, brown the apex only, slightly enlarged upwards, wiry, covered with stiff erect d-brown thick-walled hairs, about $170\,\mu$ long, tapering from about $8\,\mu$ ameter at the base to $3\,\mu$ at the rounded tip. Spores elliptic-cylindric, n-amyloid, $6-8 \times 2{\cdot}5-3\,\mu$. Cystidia wanting. Tramal hyphae thin-walled, own, $5\,\mu$ wide. (Pl. 21, fig. 6; Text-fig. 22.)

On dead sticks in montane forests.

Trinidad: Cerro del Aripo, 2000 ft., 23 October 1949, Dennis 221 ypus); Morne Bleu, 4 December 1949, Dennis 221 A.

** *Hairs of the stipe hyaline*

a. *Cystidia present on the gill face, pileus whitish*

ollybia omphalodes (Berk.) comb.nov.

Marasmius omphalodes Berk., Hooker's *J. Bot.* **8**, 138, 1856.
Marasmius cinerei-albus Murrill, *N. Amer. Flora*, **9**, 264, 1915.

Pileus 2–3 cm. diameter, convex, then expanded with an ill-defined nbo, closely and finely striate half way to the disk, cartridge-buff, ghtly darker at the umbo; flesh thin, white, clay-colour below the disk. ills crowded of three lengths, adnate, about 1·5 mm. wide, white. Stipe ual, hollow, 1–1·5 mm. thick, clay coloured at the apex, dark purplish own to black elsewhere, at first covered with a conspicuous white down mposed of septate, hyaline, obtuse hairs, up to $140 \times 5\,\mu$, with clamp nnexions, cohering in tufts, finally almost naked. Spores elliptic-lindric, $5-6(-8) \times 2{\cdot}5-3\,\mu$, print white, non-amyloid. Gill edge sparingly fringed with irregularly cylindrical, obtuse hairs about 40 × 5 μ. Similar thin-walled cylindric fusoid cystidia about 40 × 7 μ occur scattered over the gill face, where they are easily seen with a × 10 lens in dry material. Pileus surface formed of hyaline interwoven hyphae 5–8 μ wide, with clamp connexions. (Pl. 21, fig. 10; Text-fig. 23.)

On logs in forests.

Collections seen.—Brazil: Panuré, Spruce 131, February 1853 (Typus). Venezuela: Rio Chacaito, Caracas, 18 September 1949, Dennis 135A2. Trinidad: Arena Forest, 30 October 1949, Dennis 135A. Puerto Rico: Rio Piedras, 8 September 1912 (Typus of *M. cinerei-albus*).

b. Facial cystidia probably wanting. Pileus some shade of brown

Collybia hirtella (Berk. & Broome) comb.nov.

Marasmius hirtellus Berk. & Broome, *J. linn. Soc.* (*Bot.*), **14**, 39, 1875.

Pileus 1–4 cm. diameter, convex, then flattened, closely striate at the margin, undulating in large specimens, smooth, pale ochraceous-buff to ochraceous-tawny; flesh thin, white, very tough. Gills very crowded, of three lengths, narrow, adnate, white then pale buff, in large specimens sometimes irregularly forked and fused. Stipe equal, slender, about 1 mm. thick, solid, becoming hollow in age, shading from buff at the apex to bistre at the base, covered with a fine white pruina of small tufts of somewhat irregular obtuse, hyaline hairs about 60 × 5 μ. Surface of the pileus of matted hyphae. Spores hyaline, non-amyloid, elliptical to pip-shaped with a large central guttule, 5–7(–8) × 2·5–3·5 μ. Clamp connexions present. (Pl. 21, fig. 11; Text-fig. 24.)

On herbaceous stems and sticks, associated with sterile black erect strands.

Trinidad: Arena Forest, 5 October 1949, Dennis 135; same locality, 30 October 1949, Dennis 264.

The type and subsequent collections by Petch from Ceylon agree well. *M. cervinicolor* Murrill, from Jamaica, is perhaps a synonym.

Collybia subcoracina (Berk. & Curt.) comb.nov.

Marasmius subcoracinus Berk. & Curt., *J. linn. Soc.* (*Bot.*) **10**, 294, 1869.

Pileus 1–1·5 cm. diameter, convex then almost flat, smooth, wood-brown, margin finely and closely striate when moist; flesh thin, white, tough. Gills narrow, crowded, of two lengths, adnate, white. Stipe cylindrical, solid, up to 1 mm. thick, concolorous with the pileus above, darkening to dark vinaceous-brown below, covered throughout with a conspicuous white down, formed of hyaline, undulating, obtuse, thin-walled hairs up to about 70 × 5 μ. Spores pip-shaped, 6–7 × 3 μ, non-amyloid. Cystidia none on the gill face, gill edge fringed with hyaline, obtuse hairs. Pileus surface formed of interwoven hyphae with thin brown walls. Tramal hyphae hyaline, 5–7 μ wide, loosely woven. (Pl. 23, fig. 14; Text-fig. 25.)

On dead and fallen leaves and branches in forests.

Collections seen.—Trinidad: Siparia, 3 November 1949, Dennis 276, 276A; Siparia Forest Reserve, 5 November 1949. Cuba: Wright 22 (Typus).

M. picipes Murrill on *Eugenia* leaves from Cuba differs in its smooth gill ge, less crowded gills and stipe smooth above.

ollybia setulosipes (Murrill) comb.nov.

Marasmius setulosipes Murrill, *N. Amer. Flora*, **9**, 257, 1915.

Pileus less than 1 cm. diameter, convex, becoming slightly depressed at e disk, margin closely striate when moist, vinaceous-buff, surface matt; sh thin, white. Gills moderately spaced, narrow, of two lengths, adnate, hite. Stipe cylindrical, about 1 mm. thick, slightly swollen at the foot, ry light yellow, clothed throughout with a white down composed of dulating, cylindrical, hyaline, obtuse, non-septate hairs about 70 × 4 μ, ten cohering in tufts. Spores elliptical, hyaline, non-amyloid, ·7(–8) × 2·5–3 μ. Gill edge sterile, naked or fringed with a few short otuse cylindrical hairs about 17 × 4 μ. Pileus surface composed of terwoven hyphae. (Pl. 21, fig. 4.)

Occurring singly on dead leaves and sticks in forest litter.

Collections seen.—Trinidad: Arena Forest, 5 October 1949, Dennis 94A; me locality, 30 October 1949, Dennis 263. Bahamas: Lake Cunningım, New Providence, E. G. Britton 651, 8 September 1904 (Typus).

β. *Small white species on stems, roots or bark*

ollybia dealbata (Berk. & Curt.) comb.nov.

Marasmius dealbatus Berk. & Curt., *J. linn. Soc.* (*Bot.*), **10**, 296, 1869.

Pileus up to 7 mm. diameter, conico-campanulate with a recurved argin, convex, then flattened, silky white, buff at the vague low umbo; sh thin, white. Gills crowded, of three lengths, narrow, pale buff, dnexed. Stipe equal, about 1 mm. thick, solid, white, minutely pruinose ith cylindrical obtuse hairs 30–60 × 6 μ. Spores tear-shaped, 8–9·5 × 3 μ, int white, non-amyloid. Pileus surface of matted hyphae 3–5 μ wide. Pl. 20, fig. 8.)

In swarms on dead sticks, roots, petioles and midribs of fallen leaves in rest litter.

Collections seen.—Trinidad: River Estate, Diego Martin, 30 September 949, Dennis 100. Cuba: Wright (Typus).

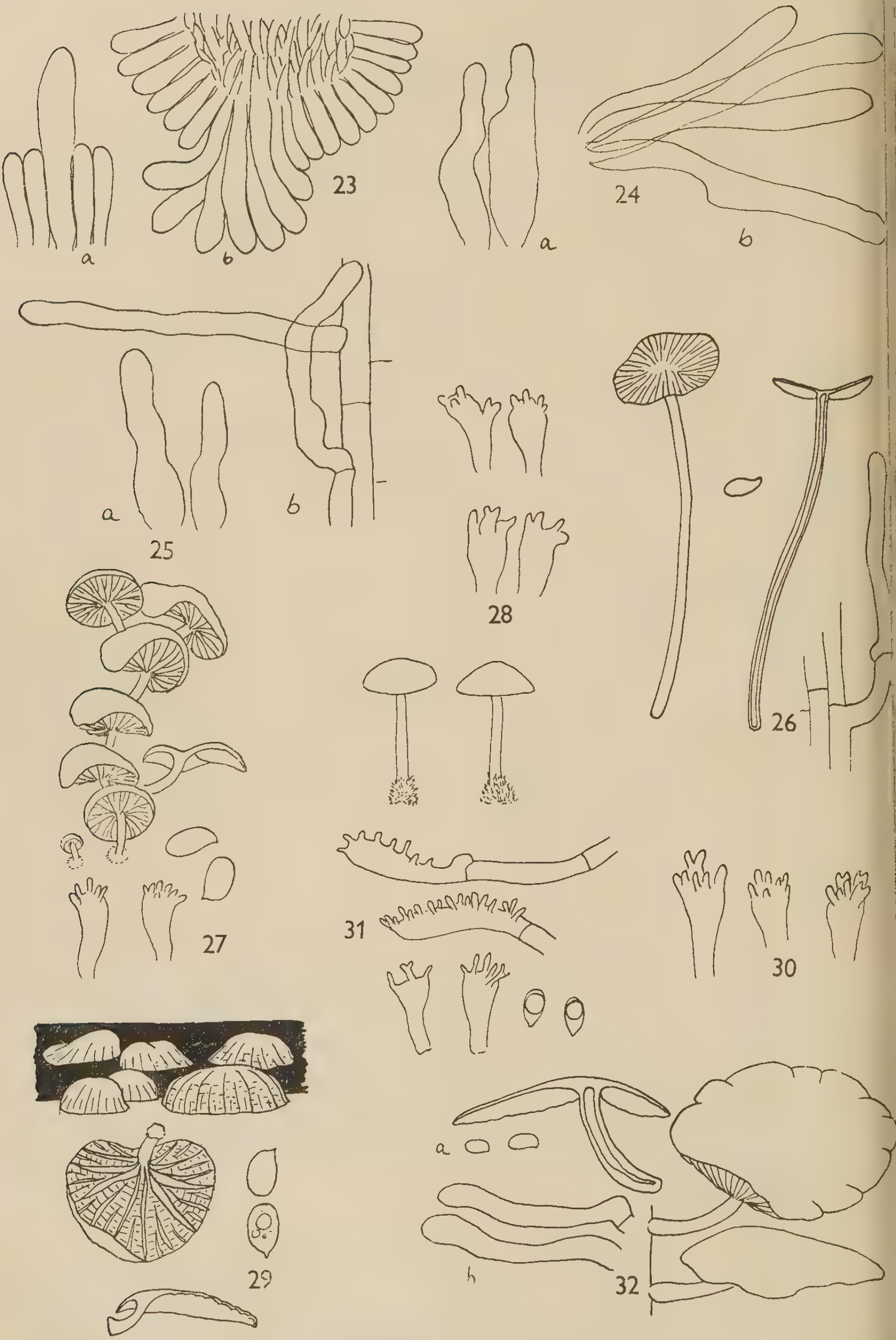
Agaricus synodicus Kunze apud Fries (1830) was apparently similar but ith slightly decurrent gills. *Marasmius earlei* Murr. differs in its smooth rk-brown stipe. It is probably a synonym of *M. arecarius* Fr. var. *tenella* Fr. om the Virgin islands. Dennis 61, on bark of living *Eschweilera* in montane rest of the northern range of Trinidad, north of Arima, 25 September 949, is like *Collybia dealbata* but with more adnate gills and spores about × 3 μ. Possibly this was *Marasmius catervatus* Massee (1892), described from Vincent with spores 6 × 4 μ.

γ. *More or less fleshy species, the pileus some shade of buff or brown*

ollybia trinitatis sp.nov.

Pileus 1–2 cm. latus, tenuis, campanulatus, margine incurvus dein expansus, tomensus, hinnuleus; lamellae confertissimae, liberae, bubalinae; stipes cylindricus, flexuosus, ellaneus, albo-pruinosus; sporae ellipticae, hyalinae 7–8 × 3·5 μ.

In culmis dejectis Bambusae, Diego Martin, Trinidad. Dennis 94 Typus.



Text-figs 23–32.

Pileus 1–1·5(–2) cm. diameter, campanulate with incurved margin, en with undulating recurved margin and broad persistent umbo, nutely tomentose, vandyke-brown or fawn at the margin, shading to naceous-buff at the umbo; flesh thin, tilleul-buff, deepening to avellaneous the stipe. Gills very crowded, of three lengths, narrow, free, vinaceous-uff. Stipe equal, about 2 mm. thick, sometimes slightly attenuated owards, flexuous, solid, chamois to avellaneous, with a fine white pruina. ores elliptical to tear-shaped, 7–8 × 3·5 μ, print white, non-amyloid. ystidia wanting. Pileus surface of interwoven hyphae 5–6 μ wide. l. 21, fig. 5.)

Trinidad: on rotting bamboo debris, River Estate, Diego Martin, September 1949, Dennis 94 (Typus); again 27 October 1949.

ollybia hemileuca (Berk. & Curt.) Sacc., *Syll. Fung.* **5**, 222, 1887

Agaricus hemileucus Berk. & Curt., *J. linn. Soc.* (*Bot.*), **10**, 285, 1868.

Marasmius hemileucus (Berk. & Curt.), Murrill, *N. Amer. Flora*, **9**, 266, 915.

Pileus 1–5 cm. diameter, flat, becoming depressed, smooth, closely riate, ochraceous-tawny; flesh thin, concolorous. Gills very crowded, three lengths, narrow, not exceeding 1 mm. wide, adnexed, pale hraceous-buff. Stipe equal, hollow, about 1·5 mm. thick, concolorous ith the pileus, minutely white-pruinose with tufts of undulating hyaline otuse hairs, occasionally septate with clamp connexions. Spores some-hat tear-shaped, 5·5–7 × 3·5 μ, print white, non-amyloid. Gill edge erile, of clavate cells 10 μ wide. Pileus surface of interwoven hyphae. /hole fungus blackens on drying. (Text-fig. 26.)

On litter in forests and plantations.

Collections seen.—Cuba: Wright 59, Herb. Berkeley (Typus). Trinidad: iver Estate, Diego Martin, cacao plantation, 22 September 1949, ennis 31; beside Tucuche trail on Naranja at about 2000 ft., 2 October 949, Dennis 31 A.

ollybia polygramma (Mont.) comb.nov.

Marasmius polygrammus Mont., *Ann. Sci. Nat.* (*Bot.*), Ser 4, **1**, 118, 1854.

Heliomyces hondurensis Murrill, *N. Amer. Flora*, **9**, 248, 1915.

Pileus up to 7 cm. diameter, soon expanded or recurved, smooth, ılcate-striate to the disk, cream coloured at the margin, shading to

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Legends to Text-figs. 23–32.

ext-fig. 23. *Collybia omphalodes:* (*a*) section of hymenium, (*b*) section of gill edge, × 660.

ext-fig. 24. *C. hirtella:* (*a*) hairs of gill edge, (*b*) hairs of stipe, × 660.

ext-fig. 25. *C. subcoracina:* (*a*) hairs of gill edge, (*b*) hairs of stipe, × 660.

ext-fig. 26. *C. hemileuca:* sporophore and section × 1; spore and hairs of stipe, × 660.

ext-fig. 27. *C. semiusta:* below, cheilocystidia and spores, × 660.

ext-fig. 28. *C. troyana:* cheilocystidia from purple form (above) and white form (below), × 660.

ext-fig. 29. *C. sabali:* sporophores, natural size; spores, × 660.

ext-fig. 30. *C. purpurea:* cheilocystidia × 660.

ext-fig. 31. *C. nana:* sporophores, × 2; hyphae from cuticle of pileus, cheilocystidia and spores, × 660.

ext-fig. 32. *C. pseudoboryana:* (*a*) spores, (*b*) hairs from stipe, × 660.

pinkish cinnamon or verona-brown at the disk; flesh thin, white, verona-brown at the disk, vinaceous-drab in the stipe. Gills moderately spaced, of three lengths, 4–6 mm. wide, sinuato-adnate, cartridge-buff. Stipe slightly attenuated upwards, 4–6 mm. thick, hollow, varying from cinnamon-brown to russet, finely shaggy throughout with light-brown hyphae 3–4 μ wide, septate with clamp connexions and cohering in strands. Spores elliptic-cylindric, (5–)7–8(–9) × 4–5(–5·5) μ. Basidia 4-spored. Cystidia wanting. Pileus surface of interwoven hyphae 5–8 μ wide. (Pl. 20, fig. 3.)

On logs in montane forests, etc.

Collections seen.—French Guiana: specimen from Montagne in Herb. Berk. Trinidad: Cerro del Aripo about 1500 ft., 23 October 1949, Dennis 723; River Estate, Diego Martin, 27 October 1949, Dennis 223A. British Honduras: Morton E. Peck, 1906 (Typus of *H. hondurensis*).

Collybia subfumosa Speg., *Bol. Acad. Cienc. de Córdoba*, **11**, 390, 1889

Gymnopus monticola Murrill, *N. Amer. Flora*, **9**, 371, 1916.
Collybia monticola (Murrill) Murrill, *Mycologia*, **8**, 219, 1916.

Pileus 6 cm. diameter, convex, smooth, margin sulcate-striate, orange-cinnamon streaked with radiating brown fibrils; flesh thin, tasteless, light brown. Gills adnate, of two lengths, about 7 mm. wide, edge often denticulate, ivory-yellow. Stipe equal or enlarged upwards, cartilaginous, stuffed with soft white hyphae, surface concolorous with the pileus but finely velvety. Spores white, non-amyloid, elliptical, 7–9 × 4–5 μ. Cystidia wanting. Pileus surface of parallel hyphae about 10–14 μ wide. Tramal hyphae about 10 μ wide. (Pl. 23, fig. 8.)

On logs.

Collections seen.—Brazil: Apiahy, Serra do Paranapiacaba, São Paulo, May 1888, Puiggari 2914 (Typus). Trinidad: River Estate, Diego Martin, about 1000 ft., 20 September 1948, Dennis 98. Venezuela: Rio Chacaito, Caracas, Dennis V27. Jamaica: Sir John Peak, Blue Mountains, 5 January 1909, Murrill 809 (Typus of *Gymnopus monticola*).

This should be compared with *Collybia luxurians* Peck from Alabama which, however, was described as caespitose.

Collybia fibrosipes (Berk. & Curt.) comb.nov.

Marasmius fibrosipes Berk. & Curt., *J. linn. Soc.* (*Bot.*), **10**, 293, 1868.
Gymnopus oculatus Murrill, *N. Amer. Flora*, **9**, 371, 1916.
Collybia oculata (Murrill) Murrill, *Mycologia*, **8**, 219, 1916.

Pileus 2–3 cm. diameter, campanulate with incurved margin, then expanded, convex with a broad umbo, smooth, cartridge-buff, shading to wood-brown at the umbo; flesh 1–1·5 mm. thick, ivory-yellow in the outer zones of the pileus, wood-brown beneath the umbo and in the stipe. Gills rather crowded and narrow, of two lengths, adnexed, ivory-yellow. Stipe equal or slightly attenuated upwards, 3–4 mm. wide, hollow, surface smooth and fibrous, shading from light vinaceous-cinnamon above to verona-brown at the base. Spores elliptical, non-amyloid, 5·5–7 × 2–2·5 μ.

Cystidia wanting. Pileus surface of more or less parallel hyphae 5–6 μ wide. (Pl. 20, fig. 9.)

On logs in montane forest.

Collections seen.—Cuba: Wright 3, Herb. Berkeley (Typus). Trinidad: eside Tucuche trail on Naranja, about 2000 ft., 2 October 1949, Dennis 21. Jamaica: Cockpit Country, January 1909, W. A. Murrill and W. Harris 1022 (Typus of *Gymnopus oculatus*).

ar. **harrisii** (Murrill) comb.nov.

Marasmius harrisii Murrill, *N. Amer. Flora*, **9**, 264, 1915.

Differs from the type in its pileus being ochraceous-tawny throughout. Apex of stipe minutely pruinose with obtuse hairs 40–55 × 7–8 μ. Spores –8 × 2·5–3 μ. Gill edge sterile with parallel hairs formed by tips of tramal hyphae, otherwise no cystidia.

Collections seen.—Trinidad: St Augustine, on banana trash, 31 October 1949, Dennis 268; Botanic Garden, Port of Spain, 25 November 1949, Dennis 268A. Jamaica: Cockpit Country, among dead leaves, 12–14 anuary 1909, W. A. Murrill and W. Harris 851 (Typus of *M. harrisii*).

Collybia subpruinosa (Murrill) comb.nov.

Marasmius subpruinosus Murrill, *N. Amer. Flora*, **9**, 266, 1915.
Marasmius obsoletus Murrill, *N. Amer. Flora*, **9**, 265, 1915.

Pileus 2–6 cm. diameter, campanulate with an ill-defined umbo, margin ncurved, strongly so and clasping the stipe when dried, striate-sulcate to the disk, smooth, vinaceous-buff to avellaneous; flesh of the pileus 1–1·5 mm. thick, tilleul-buff. Gills subdistant, of three lengths, 3–8 mm. wide, sinuate or adnate, vinaceous-buff. Stipe long, 2–7 mm. thick, often slightly enlarged upwards, solid or stuffed, vinaceous-fawn to fawn, fibrous, the surface sometimes marked with loose whitish adpressed fibrils, longitudinally striate in age. Spores elliptical or somewhat tear-shaped, non-amyloid, 7–11 × 3–4 μ. There are no cystidia but the gill edge is sometimes sterile owing to the trama not being completely covered by basidia. Pileus surface of interwoven hyphae, tramal hyphae yellowish, thin-walled, 5–8 μ wide. (Pl. 21, fig. 2.)

On logs in lowland forests.

Collections seen.—Trinidad: Non Pareil, Sangre Grande, 11 October 1949, Dennis 162; Siparia Forest Reserve, 5 November 1949. Jamaica: Castleton Botanic Garden, 16 December 1949; Cockpit Country, January 1909 (Typus of *M. subpruinosus*). Puerto Rico: Rio Piedras, 25 December 1911 (Typus of *M. obsoletus*).

This may be a synonym of *M. longipes* Mont. on dead leaves in French Guiana, with which Dennis 33, on dead leaves, River Estate, Trinidad, is probably identical. I feel, however, that further observations in the field are required before one can assign the forms on dead leaves and on logs to a single species. *M. subcyathiformis* Murrill is very similar but with umbilicate, somewhat darker pileus and hollow stipe.

Collybia brasiliensis (Berk. & Mont.) comb.nov.

Marasmius brasiliensis Berk. & Mont., *Ann. Sci. Nat.* (*Bot.*), Ser. 3, **11**, 236, 1849.

Pileus up to 4 cm. diameter, at first campanulate and hazel with paler striate margin, then flattened or recurved with undulating margin, pinkish buff shading to cinnamon or sayal-brown at the disk, smooth, sulcate-striate and slightly transversely corrugated between the main gills; flesh thin, avellaneous. Gills rather distant, of three lengths, adnate, with cross connexions especially at the ends of the secondary gills, rather broad, white. Stipe equal or slightly attenuated upwards, fibrous, flexuous or twisted, 2–4 mm. wide, cartridge-buff above shading to chamois below when young, avellaneous when old, appearing smooth even under a lens but actually bearing scattered very minute hyaline hairs about 30 × 3 μ. Spores elliptical, non-amyloid, 4–5 × 2 μ. No cystidia except that a few minute hairs like those of the stipe occur on the gill edge. Surface of the pileus formed of interwoven, non-amyloid hyphae 6–8 μ wide. Tramal hyphae similar. (Pl. 20, fig. 12.)

Amongst litter in forests.

Collections seen.—Trinidad: Arena Forest, 30 October 1949, Dennis 252. Brazil: Bahia (Typus in Herb. Berk.).

Collybia dryophila (Bull. ex Fr.) Staude, *Die Schwämme*, 1857

Agaricus dryophilus Bull. ex Fr., *Syst. Myc.* **1**, 124, 1821.

Gymnopus dryophilus (Bull. ex Fr.) Murrill, *N. Amer. Flora*, **9**, 362, 1915.

Marasmius dryophilus (Bull. ex Fr.) Karst., *Krit. Ofvers. Finlands Basidsvamp.* p. 103, 1889.

Pileus up to 4 cm. diameter, convex, then flattened or undulating, disk sometimes becoming depressed or even umbilicate, smooth, russet or fawn; flesh thin, white. Stipe equal, smooth, becoming longitudinally furrowed when dry, honey-yellow, apex paler, base white-tomentose. Spores non-amyloid, elliptical 4–5·5 × 2·75–3·5 μ. Cystidia wanting. (Pl. 21, fig. 8.)

In swarms on litter.

Trinidad: St Joseph, bamboo plantation, 20 September 1949, Dennis 9; again 18 October 1949, Dennis 9A; same locality, 30 November 1949; River Estate, Diego Martin, 27 October 1949.

When fresh this form has a rather darker pileus than most British collections of *Collybia dryophila* but is indistinguishable from them when dried. It may be *C. subdryophila* Atkinson (1909) with pileus 'purplish or pinkish brown' but the species is notoriously variable and Coker and Beardslee (1921) have reduced *C. subdryophila* to synonymy.

H. *White or purple species with marginal cystidia bearing obtuse processes*

Collybia semi-usta (Berk. & Curt.) comb.nov.

Marasmius semi-ustus Berk. & Curt., *J. linn. Soc.* (*Bot.*), **10**, 295, 1868.

Pileus up to 1·5 cm. diameter, hemispherical, becoming convex or sometimes depressed at the disk, margin sulcate-striate and wavy with age, paque, smooth, white; flesh thin, white. Gills moderately spaced, of ree lengths, broadly adnate, not interveined, white, drying cream with white edge. Stipe equal, curved, solid, 1–1·5 mm. thick, rather short, ften curved, smooth but often white-strigose at the base, white, en tinged with flesh-colour. Spores broadly elliptical, non-amyloid, –10 × 4·5–5·5 μ, print white. Pileus surface of loosely woven hyphae, amal hyphae thin-walled, 6–10 μ wide, with clamp connexions. Gill dge sterile with short, clavate, thin-walled cystidia 5–6 μ wide bearing ort, obtuse processes at the apex. (Text-fig. 27.)

In swarms on dead vegetable matter.

Collections seen.—Dominica: On *Musa*, Clarke Hall, 18 November 1920, . M. Wakefield. Trinidad: on dying *Musa* stem, St Augustine, 21 October 949, Dennis 214; on dead wood, River Estate, Diego Martin, 27 October 949, Dennis 214A.

M. inoderma Berk. from Para has spores 8–9 × 5 μ and may well be an arlier name for *Collybia semi-usta*. *Marasmius subplexifolius* Murrill, from renada, is a closely allied form with similar cystidia and spores but nger stipe and slightly interveined gills.

ollybia troyana (Murrill) comb.nov.

Marasmius troyanus Murrill, *N. Amer. Flora*, **9**, 263, 1915.

Pileus up to 2·5 cm. diameter, hemispherical becoming flattened above r slightly depressed at the disk, deep purplish vinaceous to vinaceous-lac or colourless, then sometimes tinged reddish at the disk, closely triate; flesh thin, white, tough. Gills moderately spaced, of three lengths, arrow, adnate, white. Stipe rather short, equal, about 2 mm. thick, mooth, hollow, white or tinged reddish towards the base, arising from white cord-like mycelium. Spores broadly elliptical, 7–8 × 5–6·5 μ, on-amyloid. Gill edge sterile, of clavate cystidia with five to six short, btuse, sterigma-like processes. Pileus surface formed of interwoven yphae 6–8 μ wide, tramal hyphae similar. (Pl. 22, fig. 20; Text-fig. 28.)

On palm debris.

Collections seen.—Jamaica: on palm trunk, Cockpit country, January, 909, W. A. Murrill (Typus). Trinidad: On *Cocos* petioles from the Cocal, 9 November 1949, Dennis 337A.

There seems no doubt the purple and white forms belong to the same pecies, which is closely allied to *Collybia semi-usta*, differing in the hollow tipe and propensity to develop purplish or red hues. *Marasmius palmivorus* harples (1928) is probably a member of the same group.

ollybia sabali (Berk.) comb.nov.

Marasmius sabali Berk., *J. linn. Soc.* (*Bot.*), **15**, 49, 1876.

Pileus 1–2 cm. diameter, hemispherical, then convex, often becoming rregular and flattened on one side, striate-sulcate, smooth, white, ecoming reddish brown at the disk with age and drying pale buff hroughout; flesh thin, white, tough. Gills distant, of two to three lengths, aintly interveined, adnate, white. Stipe short, equal above the slightly wollen foot, 1–1·5 mm. thick, solid, curved, becoming excentric, smooth, white, soon turning light reddish brown. Spores broadly elliptical 7–9 × 4–5 μ, print cream coloured, non-amyloid. Pileus surface of interwoven hyphae 3–5 μ wide. Cystidia wanting but the gill edge may carry a few scattered cylindrical hairs 2–3 μ wide, of varying length. The gill interstices are rather transversely corrugated than veined so that the veining is indicated by furrows on the upper surface rather than as dark lines when the pileus is viewed from below by transmitted light and is not represented in the spore print. (Text-fig. 29.)

In swarms on dead palm debris.

Collections seen.—Bermuda: on *Sabal bermudana*, H. N. Moseley, 1873 (Typus). Trinidad: on *Bactris* petioles, Siparia, 3 November 1949, Dennis 273; Erin Savanna, 6 November 1949, Dennis 273A; Quinam 4 November 1949, Dennis 273B.

Berkeley described the type as 'Pileo reniform, tomentoso demum resupinato', but at least four of the sporophores present can be seen to have well-developed excentric but not lateral stipes. Others are hidden by pressing.

Collybia purpurea (Berk. & Curt.) comb.nov.

Marasmius purpureus Berk. & Curt., *J. linn. Soc.* (*Bot.*), **10**, 299, 1868.
Marasmiellus purpureus (Berk. & Curt.), Murrill, *N. Amer. Flora*, **9**, 244, 1915.

Pileus 1–4 cm. diameter, convex, then more or less flattened with undulating margin, deep dull lavender, surface minutely tomentose, especially towards the margin, not striate; flesh thin, white under the cuticle, tough and flexible. Gills rather distant, of three lengths, pale buff, adnexed, not interveined. Stipe short, 2–3 mm. thick, equal, slightly enlarged at the base but not bulbous, covered with loose fibrils, white, solid. Spores broadly elliptical, 6–8(–10) × 4–5 μ, print white, non-amyloid. Pileus surface of matted hyphae; tramal hyphae very thin-walled, with clamp connexions, 6–12 μ broad, wine-red in Melzer's reagent. Gill edge covered with clavate cystidia about 6–7 μ broad crowned with a small number of short, obtuse processes. (Pl. 22, fig. 19; Text-fig. 30.)

In swarms on wood and plant debris.

Collections seen.—Cuba: Wright 15 (Typus) on wood. Trinidad: on dead *Musa* stems, St Augustine, 24 September 1949, Dennis 38.

Marasmius purpureo-albus Petch on *Musa* in Ceylon is described as having spores 10–14 × 5–6 μ.

Collybia nana (Massee) comb.nov.

Marasmius nanus Massee, *J. Bot., Lond.*, **30**, 161, 1892.

Pileus up to 5 mm. diameter, convex, becoming flattened, white or cream, drying pinkish buff with a reddish spot at the disk; flesh relatively thick, white. Gills distant, narrow, adnate, white. Stipe short, about ½ mm. thick, solid, equal, concolorous, the base densely white tomentose. Spores broadly elliptical 5–8 × 4–5·5 μ, non-amyloid, with a large oil drop. Basidia 4-spored. Pileus surface of recumbent hyaline hyphae, with clamp connexions, 3–4 μ wide, their terminal cells bearing numerous short obtuse processes. Towards the pileus margin these terminal cells become erect as clavate pilocystidia about 30 × 8 μ with a few blunt processes at the tip. Cystidia of the gill edge clavate to pyriform about 15 × 6–10 μ with few or many short processes. (Text-fig. 31.)

Gregarious on decorticated wood and dead leaves.

Trinidad, River Estate, Diego Martin, 22 September 1949, Dennis 25 and 17.

The above five species obviously form a natural group and are closely interrelated, so much so that I have considered treating the four previous members as one variable species. It seems, however, unwise to do so until more critical studies have been undertaken with numerous collections of living material. In their broadly elliptical spores and clavate cystidia with obtuse processes they approach *Mycena*, and I have placed them in *Collybia* because of their tough, non-putrescent character and a tendency to an inrolled pileus margin when young.

J. *White species or purple species with elliptical spores less then* 6 μ *long, hyphal cuticle and no cystidia*

Collybia pseudoboryana sp.nov.

Gregarius; pileus 3 cm. latus, convexus dein expansus, margine flexuosus, tenuis, glaber, albus; lamellae confertissimae, adnatae, albae, acie denticulatae; stipes incurvus, cylindricus, fistulosus, albus; apice pruinosus; sporae ellipticae, hyalinae 4–5·5 × 2·5–2·75 μ. Ad corticem truncorum putrescentium in sylvis, Naranja, Trinidad. Dennis 116 Typus.

Pileus up to 3 cm. diameter, convex, becoming flattened with an undulating margin, smooth, white or becoming buff at the disk only; flesh white, tough. Gills very crowded, of two to three lengths, thin, adnate, edge denticulate, white. Stipe equal, 2–3 mm. thick, hollow, curved, sometimes becoming excentric with age, smooth below, apex white-pruinose with tufts of short, white, obtuse, thin-walled, hyaline hairs about 40 × 4 μ. Spores elliptical, non-amyloid, 4–5·5 × 2·5–2·75 μ, print white. Cystidia wanting, occasionally a few scattered hairs on the gill edge. Pileus surface formed of interwoven hyphae, tramal hyphae 7–9 μ wide, thin walled, non-gelatinized, non-amyloid, running parallel in the gills. (Text-fig. 32.)

Gregarious on logs.

Collections seen.—Trinidad: beside Tucuche trail on Naranja, about 2000 ft., 2 October 1949, Dennis 116 (Typus); on bamboo stools, St Augustine, 20 October 1949, Dennis 116A.

Superficially this resembles *C. boryana* (Berk. & Mont.) Sacc. from Brazil, but examination of the type shows that to be a *Micromphale* with gelatinized tramal hyphae and more wedge-shaped gills.

Collybia sericipes (Berk. & Curt.) comb.nov.

Marasmius sericipes Berk. & Curt., *J. linn. Soc.* (*Bot.*), **10**, 294, 1869.

Pileus up to 3 cm. diameter, convex, then flattened, often with a shallow central umbilicus, margin striate, smooth, often undulating, disk very minutely tomentose, etruscan-red to dull indian-purple; flesh thin, somewhat hygrophanous, concolorous. Gills rather crowded, of two to three lengths, broadly adnate, not interveined, vinaceous-buff. Stipe slightly enlarged downwards, smooth, hollow, about 3 mm. wide, concolorous or brownish at the base. Spores non-amyloid, broadly elliptical, $4{\cdot}5$–$5{\cdot}5 \times 3\,\mu$. Cystidia wanting, gill edge fertile. Basidia 4-spored, 5–6 μ diameter. Pileus surface formed of interwoven hyphae 8–14 μ wide. (Pl. 20, fig. 10.)

Collections seen.—Cuba: Wright 56 (Typus). Trinidad: in clusters on and round burnt bamboo stools, St Joseph, 27 September 1949, Dennis 79. Venezuela: on logs, Rancho Grande, Maracay, 19 November 1949, Dennis 79A.

Judging by Oersted's drawing of the type *Omphalia carneola* (Fr.) Sacc. from Costa Rica is somewhat similar. I doubt if *Marasmius badius* Berk. & Curt. is distinct from *Collybia sericipes*.

Collybia cubensis (Berk. & Curt.) comb.nov.

Marasmius cubensis Berk. & Curt. *J. linn. Soc.* (*Bot.*), **10**, 296, 1868.

Very young pileus hemispherical with incurved margin and a fine fibrillose veil, soon becoming campanulate then convex, often depressed round the small low umbo, 2–3 cm. deeply sulcate-striate and corrugated transversely between the striae, smooth, white or very pale buff; flesh thin, white, tough; gills adnate, of two to three lengths, conspicuously interveined, white; stipe equal, base slightly swollen, smooth, white, 1–$1{\cdot}5$ mm. wide, hollow. Pileus surface of interwoven hyphae about 8 μ wide. Cystidia none. Spore print white, non-amyloid, spores tear-shaped, $(10–)13–15(–21) \times 4–5\,\mu$. (Text-fig. 33.)

Caespitose on dead wood and plant debris.

Trinidad: on dead sticks, in montane forest, Aripo, 23 October 1949, Dennis 37B; on dead erect *Musa* stem, St Augustine, 24 September 1949, Dennis 37; on bamboo baskets used for cacao plants St Augustine, 8 October 1949.

The form on *Musa* has spores slightly larger ($14–19(–21) \times 4–5\,\mu$) than that on sticks ($13–15 \times 4–5\,\mu$). *Marasmius tenerrimus* Berk. & Curt., also from Cuba, has spores $13–15 \times 4\,\mu$ and is probably a synonym of *Collybia cubensis* or of *C. longicystis*. So also is the earlier *Marasmius coilobasis* Berk. from Brazil, the type of which has yielded no spores.

Collybia longicystis (Heim) comb.nov.

Mycena (*Hemimycena*) *longicystis* Heim, *Rev. mycol.* **10**, 10, 1945.

Pileus 1–2 cm. hemispherical, then convex, striate-sulcate and transversely corrugated at the margin, smooth, white; flesh thin, white, tough; gills adnate, of two to three lengths, much interveined, white; stipe equal above the slightly swollen base, about 1 mm. thick, solid, white, minutely downy with delicate hyaline hairs like the cystidia. Pileus surface of loosely interwoven hyaline hyphae 8–11 μ wide. Gill edge fringed with cylindrical or slightly ventricose thin-walled hyaline cystidia $50–60 \times 5–6\,\mu$, clearly visible under a hand-lens in dried specimens. Spore print white, non-amyloid, spores tear-shaped, 13–19 × 4–5 μ, often with a large oil drop. (Text-fig. 34.)

Gregarious on plant debris.

Trinidad: on dead and fallen *Cocos* leaves, the Cocal, 22 November 1949, Dennis 334.

This may be no more than a variety of the preceding, but the conspicuous cystidia seem to afford a distinctive character.

K. *Spores blue-amyloid* (*Baeospora* Singer, as genus in *Rev. mycol.* (N.S.), **3**, 193, 1938)

Collybia erinensis sp.nov.

Pileus 1·5 cm. latus, tenuis, convexus, bubalinus, umbone minuto, brunneo; lamellae ubconfertae, adnatae vel denticulo subdecurrentes, concolores; stipes cylindricus, istulosus, bubalinus deorsum fulvus, pruinosus; sporae ellipsoidae, hyalinae, amyloideae 6–8 × 4·5–5 μ; cystidia cylindrica, hyalina 40–50 × 7–10 μ.

Ad terram in sylvis, Erin, Trinidad. Dennis 305 Typus.

Pileus about 1·5 cm. diameter, convex, cream-buff, with a minute low dark brown umbo, very minutely downy, not striate; flesh thin, concolorous. Gills moderately spaced, of two lengths, rather narrow, adnate with a small decurrent tooth, concolorous. Stipe equal, 1–1·5 mm. thick, hollow, concolorous with the pileus above, shading to tawny below, pruinose with short cylindrical or pointed, thin-walled, hyaline hairs about 50 × 7 μ. Spores broadly elliptical, 6–8 × 4·5–5 μ, strongly blue-amyloid. Pileus surface of slender hyphae 7–8 μ wide, bearing scattered short hairs like those of the stipe, overlying a trama of large elliptical cells. Gill edge fringed with similar hairs 40 × 10 μ. (Pl. 22, fig. 5; Text-fig. 35.)

Solitary, on the ground in scrubby woodland.

Erin, Trinidad, 6 November 1949, Dennis 305.

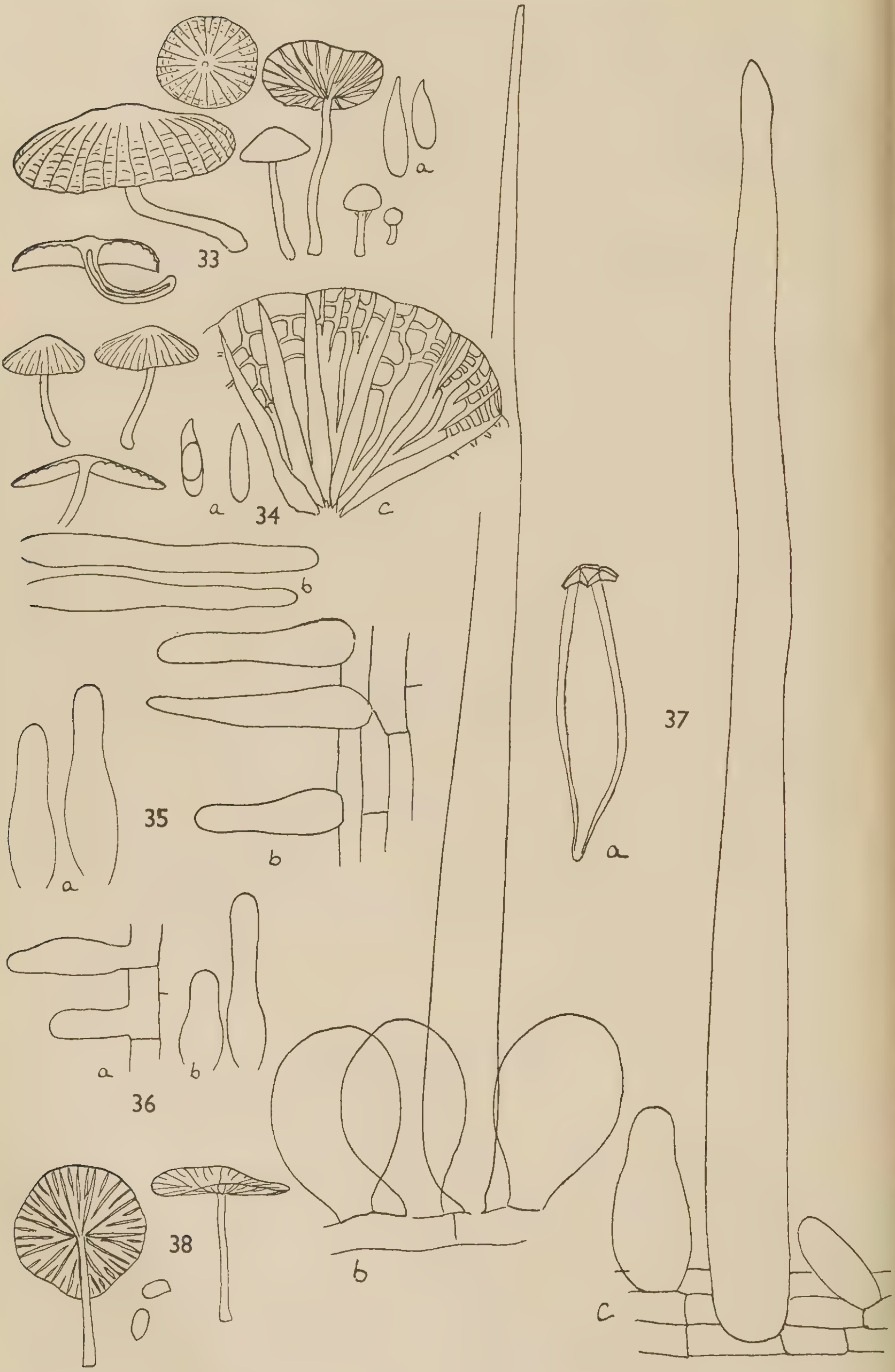
Structurally this recalls *Mycena arenaria* A. H. Smith, but seems to fall more naturally in *Collybia*. *C. erinensis* bears a striking resemblance to *C. brunneo-umbonata*, from which it differs in the reaction of the spore wall to iodine. This difference has been repeatedly confirmed on the dried material of 305 and J 66.

Collybia pleurotoides sp.nov.

Pileus 2 cm. latus, tenuis, hygrophanus, convexus, glaber, argillaceus; lamellae confertissimae, adnatae, albae; stipes excentricus, incurvus, fistulosus, albus, pruinosus; sporae subglobatae, 4–5 × 4 μ, hyalinae, amyloideae; cheilocystidia ventricosa, hyalina, 25–35 × 7 μ.

Ad ramenta putrida, Diego Martin, Trinidad. Dennis 247 Typus.

Pileus about 2 cm. diameter, convex, smooth, dry, elastic, clay-colour, paler at the margin, not striate; flesh thin, hygrophanous, concolorous, drying white. Gills very crowded, of three lengths, narrow, adnate, white. Stipe equal, tough, hollow, concolorous, very minutely white-pruinose with short hyaline obtuse hairs 15–24 × 7 μ. Spores subglobose, 4–5 × 4 μ, blue-amyloid. Gill edge sterile with ventricose thin-walled, hyaline hairs 25–35 × 7 μ below, about 5 μ at the tip, no cystidia on the gill face. Cuticular hyphae up to 18 μ wide, closely interwoven, bearing scattered



Text-figs. 33–38.

wny hairs like those of the stipe. Tramal hyphae similar, closely packed, in-walled, 8–12 μ wide. (Text-fig. 36.)

On dead and fallen sticks.

River Estate, Diego Martin, Trinidad, 27 October 1949, Dennis 247.

Gymnopus marasmiiformis Murrill has similar spores and gill edge, but the ll faces bear abundant flask-shaped cystidia.

MICROMPHALE S. F. Gray, *Nat. Arrang. Brit. Pl.* **1**, 621, 1821

Type species *Agaricus venosus* Pers. = *Ag. foetidus* Sow. ex Fr.

With some hesitation I have decided to separate from *Collybia* a group species in which the tramal hyphae have thick, hyaline, more or less latinized walls and to accept for them the name *Micromphale* typified as commended by Singer and Smith (1946) and approved by Donk (1949). elatinization has, however, proceeded much further in *Agaricus foetidus* an in most of the species dealt with here. If this peculiar hyphal ructure is accepted as the basis of a genus it can be subdivided on similar nes to *Collybia*, viz.

Spores non-amyloid:
A. Pileus cuticle hymeniform (*Pseudohiatula* Singer). *M. irrorata*
B. Pileus cuticle of parallel or woven hyphae:
  1. Pileus white. *M. subtranslucens*
  2. Pileus light yellow. *M. lutea*
  3. Pileus some shade of brown. *M. subavellanea*

. Spores amyloid (subgenus *Heimiomyces* Singer):
A. Pileus cuticle hymeniform. *M. rheicolor*
B. Pileus cuticle of parallel hyphae:
  1. Pileus cream-coloured. *M. roriduliformis*
  2. Pileus buff to olive. *M. convexa*

Compare also *Collybia pilosa*, p. 435.

icromphale irrorata (Pat.) comb.nov.

Collybia irrorata Pat. apud Duss, *Enum. Meth. Champ. Guad. et Mart.* . 49, 1903.
Prunulus pubescens Murr., *N. Amer. Flora*, **9**, 341, 1916.
Mycena pubescens (Murr.) Murr., *Mycologia*, **8**, 221, 1916.
Pseudohiatula irrorata (Pat.) Singer, *Lilloa*, **22**, 320, 1951.

Pileus up to 14 mm. diameter, convex, flattened or slightly depressed at he disk, margin at first incurved, closely striate, white, then pale pinkish uff, drying dark brown, minutely downy; flesh thin, white beneath the lark brown cuticle, flexible. Gills crowded, of three lengths, adnate, hite. Stipe cylindrical, slightly expanded at the foot 1–1·5 mm. thick, hite above, concolorous with the pileus below, covered with fine white

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Legends to Text-figs. 33–38.

ext-fig. 33. *Collybia cubensis:* (*a*) spores, × 660.
ext-fig. 34. *C. longicystis:* (*a*) spores, (*b*) cheilocystidia, × 660; (*c*) plan of gills, × 3.
ext-fig. 35. *C. erinensis:* (*a*) cheilocystidia, (*b*) hairs of the stipe, × 660.
ext-fig. 36. *C. pleurotoides:* (*a*) hairs of the stipe, (*b*) cheilocystidia, × 660.
ext-fig. 37. *Micromphale irrorata:* (*a*) pleurocystidium, (*b*) surface of pileus, (*c*) surface of stipe, all × 660.
ext-fig. 38. *Micromphale subavellanea:* soaked up type, × 1; and spores from it, × 660.

down. Spores non-amyloid, ellipsoidal with a conspicuous apiculus, 5–5·5 × 3·5–4 μ. Surface of the pileus formed of pyriform thin-walled cells, at first colourless, ultimately with dark-brown contents, interspersed with hyaline thin-walled setae about 75–200 μ long, tapering from a slightly bulbous base 20 μ wide, to a rounded tip about 4 μ wide. Trama of rather loosely woven, hyaline, non-amyloid hyphae about 7 μ wide, embedded in a colourless gelatinous matrix, clamp connexions not seen. Cystidia very abundant on both edge and face of gill, ventricose, thick-walled about 50 × 12–18 μ, narrowed to about 5–7 μ at the obtuse apex which is often encrusted. Hairs of the stipe thin-walled, hyaline, tapering, about 120–250 × 16 μ, interspersed with small vesicles about 20–30 × 8–13 μ. (Pl. 22, fig. 13; Text-fig. 37.)

In swarms on rotten logs in montane forest.

Trinidad: beside Tucuche trail on Naranja, about 2000 ft., 2 October 1949, Dennis 117. Venezuela: Mt. Periquito, Rancho Grande, Maracay, 20 November 1949, Dennis 117A.

Patouillard's type was from Guadeloupe. I have not seen it, but his excellent and very precise description leaves little doubt of its identity with my 117. Murrill's type was from Jamaica. It could not be recognized from his diagnosis, which gives no indication of the distinctive characters, but it has been well redescribed by Smith (1947, p. 460). Oersted's drawings of *Hiatula ciliatula* (Fr.) Sacc. are suspiciously like *Micromphale irrorata*, but one would like to know more about the 'ciliis ocule armato conspicuendis' which Fries saw on the pileus.

Micromphale subavellanea (Murrill) comb.nov.

Heliomyces subavellaneus Murrill, *N. Amer. Flora*, **9**, 248, 1915.

Pileus 2–3 cm. diameter, convex with a low umbo, margin distinctly striate-sulcate, umbo cream-buff, margin cinnamon-buff; flesh very thin, white in the pileus, buff in the stipe, tough and flexible. Gills distant, of three lengths, only about ten reach the stipe, adnate with decurrent tooth, 3 mm. broad, cartridge-buff. Stipe equal, about 2 mm. thick, cartridge-buff above, shading to sayal-brown below, minutely downy at the apex with short cylindrical hyaline hairs 30–40 × 4–5 μ. Spores elliptical, 5–7 × 2·5–3 μ, print white, non-amyloid. Pileus surface of interwoven hyphae 12–14 μ wide; tramal hyphae slender, closely packed, with thick gelatinized walls, their free ends exposed to form a sterile gill edge. No cystidia on the gill face. (Text-fig. 38.)

On the ground in forests.

Collections seen.—Trinidad: Arena Forest, 30 October 1949, Dennis 261. Puerto Rico: Rio Prieto, 690–1035 m., 10–15 August 1914, J. A. Shafer 3690 (Typus).

Micromphale lutea sp.nov.

Gregarius; pileus 1–2 cm. latus, tenuis, lentus, subpellucidus, convexus dein expansus vel subumbilicatus, sulcato-striatus, glaber, primulinus; lamellae subremotae, adnatae, pileo concolores; stipes incurvus, fistulinus, glaber, primulinus; sporae ellipticae, hyalinae 5 × 3μ.

Ad lignum in sylvis prope Arima, Trinidad. Dennis 422 Typus.

Pileus 1–2 cm. diameter, convex, flattened or slightly depressed at the sk, sulcate-striate, smooth, marguerite to primrose-yellow, turning nkish buff in patches with age; flesh thin, tough, concolorous. Gills bdistant, of three lengths, rather narrow, adnate, concolorous. Stipe ual, about 1 mm. thick, curved, smooth, concolorous, hollow. Spores iptical 5 × 3 μ, print white, non-amyloid. Pileus surface of closely interoven hyphae 3–4 μ wide, bearing short lateral branches swollen to up to μ, sometimes with a few minute crystals adhering to their walls. Tramal phae about 3 μ wide, non-amyloid, with thick gelatinized walls, their ee ends protruding as sterile hairs about 25 × 4 μ in the gill edge. l. 22, fig. 8.)

In swarms on decaying wood in montane forest.

Trinidad: crest of the northern range, north of Arima, 4 November 1949, ennis 422 (Typus).

This species seems akin to *Heliomyces rubritinctus* Murrill from British onduras which is, however, quite a different colour. Very similar, too, is *arasmius brachypus* Speg. on *Casuarina* trunks, La Plata, Argentina, with ighly gelatinized trama and globose spores 5–6 μ diameter, but a brown leus and stipe.

icromphale subtranslucens sp.nov.

Pileus 1 cm. latus, carnosus, expansus, centro depresso, glaber, margine substriatus, bidus, in sicco ater, carne subgelatinosa; lamellae subremotae, crassiusculae, subllucidae, albae, subdecurrentes; stipes cylindricus, fistulosus, albus, pruinosus cm. × 1 mm.; basidia bispora; sporae ellipticae, hyalinae 7–8 × 4–5 μ.

Ad lignum putridum, Sangre Grande, Trinidad. Dennis 196 Typus.

Pileus 1 cm. diameter, flat with a small umbilicus, smooth, slightly riate at the margin, white greyish at the umbilicus when moist, drying lmost black; flesh moderately thick, flexible, white. Gills subdistant, of wo lengths, subdecurrent, thick, narrow and somewhat wedge-shaped, hite. Stipe short, equal, about 1 mm. thick, hollow, white, minutely owny with undulating, hyaline, obtuse, non-septate, thin-walled hairs bout 40 × 5 μ. Spores elliptical, non-amyloid, 7–8 × 4–5 μ. Basidia -spored, 5–6 μ wide. Pileus surface formed of more or less parallel yphae 5–7 μ wide, the cells about 50 μ long. Trama homogeneous, of ender hyphae about 3 μ wide in a gelatinous matrix. Gill edge broadly ounded, fertile, no cystidia. (Text-fig. 39.)

Occurring singly on dead and rotten wood.

Trinidad: Non Pareil, Sangre Grande, 19 October 1949, Dennis 196.

It is tempting to identify this collection with *Heliomyces translucens* Murrill, which is about the same size and has 2-spored basidia with spores –10 × 4–5 μ, non-amyloid. But that had a smooth stipe and did not lacken on drying.

Micromphale convexa (Murrill) comb.nov.

Omphalopsis convexa Murrill, *N. Amer. Flora*, **9**, 316, 1916.
Omphalopsis subavellanea Murrill, *N. Amer. Flora*, **9**, 317, 1916.
Omphalia convexa (Murrill) Murrill, *Mycologia*, **8**, 220, 1916.
Omphalia subavellanea (Murrill) Murrill, *Mycologia* **8**, 220, 1916.

Pileus 1 cm. diameter, conical, then convex or slightly flattened at the disk, not umbilicate, smooth, margin slightly striate, cinnamon-buff to tawny-olive; flesh thin, thick at the disk, flexible, clay-coloured. Gills rather crowded, of two to three lengths, occasionally forked, decurrent by a tooth, interveined at the base, white or cream coloured. Stipe equal, 1–1·5 mm. thick, short, tough, hollow, concolorous with the pileus above, tawny to russet below, the base white-strigose, the apex minutely pruinose with short ventricose hairs about $20 \times 8\,\mu$. Spores elliptic-cylindric, $3–5 \times 2–2·5\,\mu$, print white, blue-amyloid. Basidia 4-spored, about $12 \times 3\,\mu$. Cystidia wanting. Pileus with a hyaline pellicle of slender hyphae with gelatinized walls overlying a brown subcuticular layer of broad, thin-walled, non-gelatinized hyphae. Trama of hyaline hyphae about $4\,\mu$ wide with gelatinized walls. (Pl. 23, fig. 11.)

Gregarious on logs in montane forest.

Collections seen.—Venezuela: El Junquito 5800 ft., 16 November 1949, Dennis 347; also at Rancho Grande, Maracay. Jamaica: Cockpit Country, 12–14 January 1909, Murrill 1003 (Typus of *O. subavellanea*). Castleton Gardens, 14–15 December 1908 (Typus of *O. convexa*).

The collections cited differ only in the degree of veining between the gills. In *O. convexa* it is almost wanting, it is feebly developed in Dennis 347 and conspicuous in *O. subavellanea.*

Micromphale roriduliformis (Murr.) comb.nov.

Omphalopsis roriduliformis Murrill, *N. Amer. Flora*, **9**, 317, 1916.

Pileus 3–8 mm. diameter, hemispherical with a small acute umbo, pellucidly striate, cartridge-buff, shading to chamois at the umbo, smooth; flesh thin, tough, cartridge-buff. Gills crowded, of two lengths, comparatively wide, conspicuously interveined when fresh, not so when dried, adnate and decurrent by a tooth, cartridge-buff. Stipe equal, about 1 mm. thick, solid, minutely pruinose, cream-buff. Spores elliptical, $4–5·5 \times 2·5\,\mu$, print white, blue-amyloid. Pellicle of the pileus formed of more or less parallel hyaline or yellowish hyphae $5–8\,\mu$ wide, with clamp connexions, in a gelatinous matrix. The underlying trama and core of the gills is formed of thin walled hyphae $18\,\mu$ wide, their non-gelatinized walls stained red-brown in Melzer's reagent. Subhymenium thick, of slender hyphae like those of the pellicle. Gill edge sterile, of cylindrical or ventricose and irregularly lobed, thin-walled, hyaline cells about $40 \times 9–11\,\mu$. (Pl. 22, fig. 18; Text-fig. 40.)

Gregarious on dead wood.

Collections seen.—Trinidad, Arena Forest, 1 December 1949, Dennis 415. Jamaica: Troy, Cockpit Country, 12–14 January 1909, Murrill 964 (Typus).

Were it not for the tough texture this species might be sought in *Mycena.*

Micromphale rheicolor (Berk.) comb.nov.

Agaricus rheicolor Berk., *Ann. Mag. nat. Hist.* **3**, 376, 1839.
Agaricus (*Collybia*)? *aurantiellus* Speg., *An. Soc. cient. argent.* **16**, 246, 1883.
Collybia rheicolor (Berk.) Sacc., *Syll. Fung.* **5**, p. 214, 1887.

Collybia aurantiella (Speg.) Sacc., *Syll. Fung.* **5**, p. 221, 1887.

Heliomyces rheicolor (Berk.) Speg., *Bol. Acad. Cienc. Córdoba*, **28**, 297, 26.

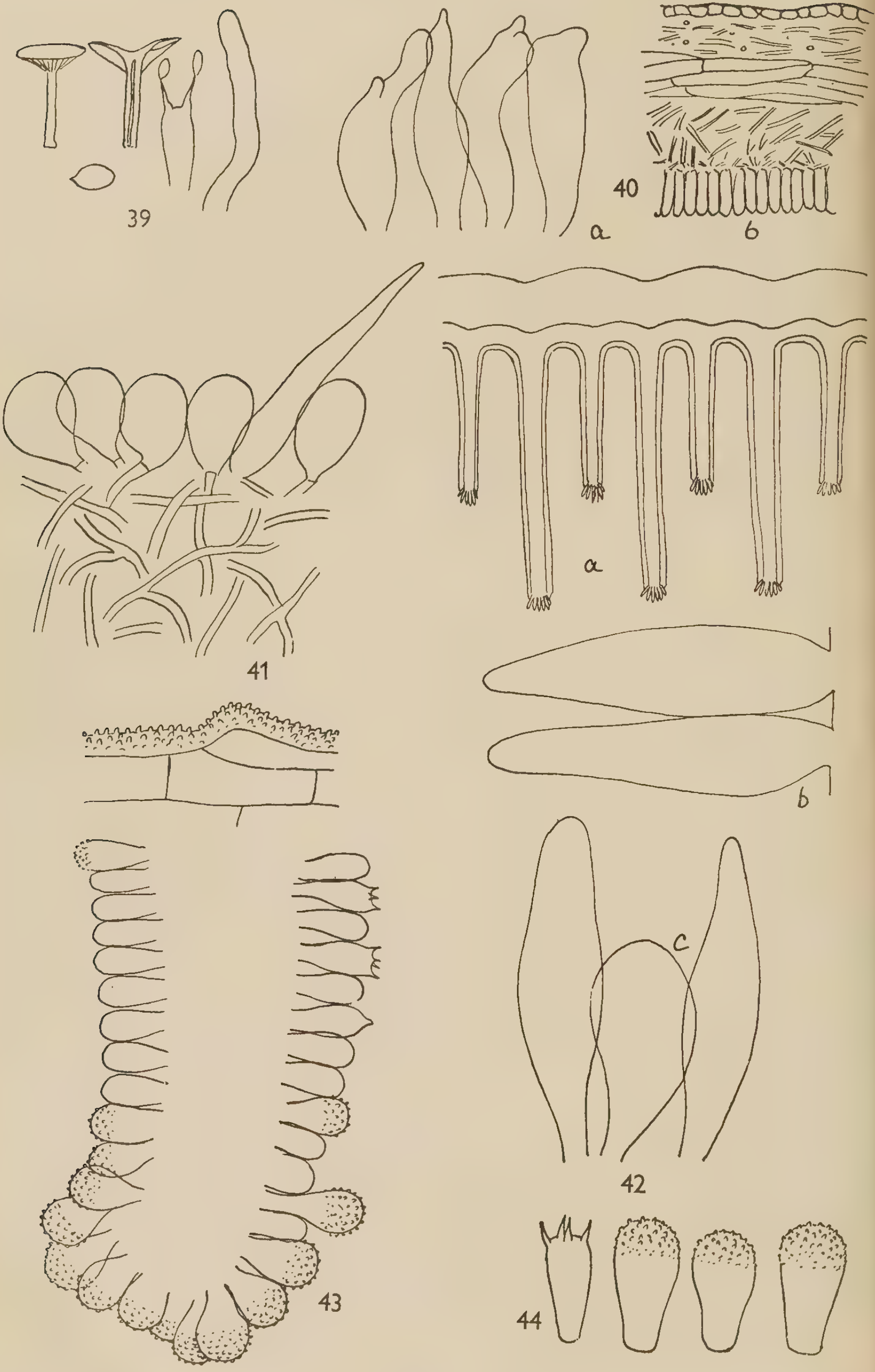
Heimiomyces rheicolor (Berk.) Singer, *Lloydia*, **5**, 127, 1942.

Pileus up to 6 cm. diameter, convex, then flattened, or depressed round shallow umbo, pruinose, striate to the disk and reticulately furrowed, ars-yellow, deepening to brussel's-brown at the disk; flesh thin, flexible, dan-brown. Gills subdistant, of two lengths, broad, sinuate, con- cuously interveined in all but the smallest sporophores, light cadmium. ipe equal, 3–6 mm. thick, hollow, lemon-chrome, darkening to raw- nber with age, downy with undulating, obtuse, unicellular hairs about 5 μ wide, with thick, yellow-brown walls. Spores elliptic-cylindric, 7 × 3 μ, blue-amyloid. Surface of the pileus formed of pyriform cells –12 μ diameter with brown walls, interspersed with scattered brown ae. Trama of hyaline, loosely woven hyphae 2–3 μ wide embedded in colourless gelatinous matrix. Cystidia wanting. The general appearance this species recalls *Collybia velutipes* (Curt. ex Fr.) Quél., as noted by rkeley when he described the type in the Hooker herbarium. (Pl. 23, . 1; Text-fig. 41.)

Caespitose on logs and stumps in forests.

Collections seen.—Brazil: Minas Geraes, Gardner, Herb. Hooker ypus.) Paraguay: Caa-guazu, January 1882, Balansa 3384 Typus of *aricus aurantiellus*). Venezuela: Herb. Berk. Trinidad: crest of northern nge, north of Arima, 25 September 1949, Dennis 47; again on the same ump, 4 December 1949; beside Maqueripe trail at about 1000 ft. north Diego Martin, 30 September 1949, Dennis 47A; east side of Piedra anca, head of the Caura Valley, 13 September 1949, Dennis 47B. Cuba: right 18, 19, 34, 57, 61, 859, Herb. Berk.

This is the type species of *Heimiomyces*, but Singer (1943) later identified with *Agaricus tenuipes* Schwein. 1832, and changed the name to *Heimio- yces tenuipes* (Schwein.) Singer. That may be so, but I prefer for the present adhere to the well-established epithet *rheicolor*. Singer (1943) cited in nonymy *Marasmius amabilis* Peck 1879 and *Ag. rhabarbarinus* Berk. uthentic material in Curtis herbarium'. But the type of *Ag. rhabar- rinus* at Kew is quite different, see *Marasmius leoninus*, p. 419. The error ems to have arisen in connexion with Wright no. 57 from Cuba. In the anuscript notes on these fungi, apparently from Curtis, now at Kew, we ad under Fungi Cubenses Wrightiani, 29 March 1859: '57. *A. rhabar- rinus* B. on rotting wood in open fields. Cap slightly arched or flattened, in, light yellowish brown. Gills numerous, unequal, adnate, very light ownish, connected by numerous cross partitions, (narrow), forming on e lower surface of the cap many areolae. Stipe hollow, brown, subpul- erulent. Ring wanting, spores white.' This description could well apply *Marasmius polyporoides*, but the specimen is *Collybia rheicolor* and has been determined by Berkeley. Possibly it was the duplicate of this collection the Curtis herbarium, misdetermined by Curtis, that misled Singer.



Text-figs. 39–44.

MYCENA S. F. Gray, *Nat. Arrang. Brit. Pl.* **1**, 619, 1821

Type species: *Agaricus galericulatus* Scop.

Smith (1947) has indicated the difficulty in defining *Mycena*, and specially of separating it from *Collybia* and *Omphalia*. I have, here, llowed the broad conception of the genus adopted by him and earlier y Kühner (1938). From *Collybia* it is separated by the softer, fleshier ileus and cartilaginous tubular stipe and by the pileus margin usually not eing incurved when young. *C. nana* and its allies are transitional species. rom *Omphalia* it differs in the gills being scarcely decurrent except in age n some small species, and the pileus not, or only feebly, umbilicate.

Mycena appears to be a north temperate genus poorly represented in he tropics. Most of the species here assigned to it are minute somewhat typical members with non-amyloid spores.

Spores distinctly blue-amyloid:
- A. Pileus with a viscid pellicle, stipe dry, gills almost free. *M. margarita*
- B. Stipe with a viscid coating, pileus dry. *M. rorida*
- C. Neither stipe nor pileus viscid:
  - 1. Stipe with red juice. *M. pseudocrocata*
  - 2. No coloured juice:
    - *a.* Marginal cystidia brush-like, on bark. *M. pseudocorticola*
    - *b.* Cystidia pointed-fusiform with brown contents. *M. sabali*
    - *c.* Cystidia ventricose, hyaline:
      - α. Pileus brown. *M. fuliginella* var. *brevispora*
      - β. Pileus white or cream coloured. *M. translucentipes*

Spores non-amyloid, or so feebly that the reaction is not evident on spores examined microscopically in daylight:
- A. Gills ascending, pileus dark grey-brown:
  - 1. Minute species with the pileus less than 1 cm. across. *M. trinitatis*
  - 2. Larger caespitose, lignicolous species. *M. parabolica*
- B. Gills horizontal or slightly decurrent, pileus seldom exceeding 1 cm. across:
  - 1. Pileus brown. *M. serotina*
  - 2. Pileus dark grey, umbilicate, closely striate. *M. umbilicata*
  - 3. Pileus lemon-yellow. *M. citricolor*
  - 4. Pileus white, mealy with sphaerocysts. *M. osmundicola*
  - 5. Pileus white or cream, not mealy:
    - *a.* Marginal cystidia brush-like:
      - α. Short processes or brush-like cells present on the pileus cuticle. see *Collybia nana*
      - β. No such bodies on the pileus. *M. theobromicola*
    - *b.* Cystidia hair-like:
      - α. Stalk long, pileus umbonate, on leaves. *M. micropapillata*
      - β. Stalk short, without an umbo, on wood. *M. marbleae*

Legends to Text-figs. 39–44.

Text-fig. 39. *Micromphale subtranslucens:* sporophores and section, natural size; spore, basidium and hair of the stipe, ×660.

Text-fig. 40. *M. roriduliformis:* (*a*) cheilocystidia, (*b*) tangential section of pileus, explanation in text.

Text-fig. 41. *M. rheicolor:* section of pileus cuticle, ×660.

Text-fig. 42. *Mycena margarita:* (*a*) tangential section of pileus, ×20; (*b*) caulocystidia, (*c*) cheilocystidia, ×660.

Text-fig. 43. *M. pseudocrocata:* above, section of pileus cuticle; below, section of gill edge, ×660.

Text-fig. 44. *M. pseudocorticola:* basidium and cystidia from Dennis 388, ×660.

Mycena margarita (Murrill) Murrill, *Mycologia* **8**, 220, 1916

Prunulus margarita Murrill, *N. Amer. Flora*, **9**, 340, 1916.

Pileus 1–2 cm. diameter, convex, becoming expanded, white with a buffy brown umbo and broad buffy striae reaching almost to the margin, sulcate-striate, viscid; flesh with a viscid detachable pellicle overlying a brown trama. Gills subdistant, of two lengths, rather broad, free, leaving a space round the apex of the stipe, white. Stipe equal or slightly enlarged at the foot, dry, fibrillose, hollow, white, 2–3 mm. thick. Spores broadly elliptical, 5–8 × 3·5–4 μ, print white, blue-amyloid. Surface of the pileus formed of undulating hyaline hyphae 1–2 μ wide, embedded in colourless mucilage. Trama of loosely woven slender brown hyphae; subhymenium also loosely woven but of hyaline hyphae. The gills are somewhat parallel-sided with no cystidia on the face but obtuse margins fringed with ventricose to fusiform, pointed or obtuse, hyaline, thin-walled cystidia about 50–70 × 10–20 μ. Similar bodies occur on the stipe. (Pl. 23, fig. 10; Text-fig. 42.)

Gregarious on stumps and logs in montane forest.

Trinidad: crest of northern range, north of Arima, 3 December 1949, Dennis 425. Venezuela: El Junquito, 16 November 1949, Dennis 357.

This very distinctive species agrees tolerably with *Mycena margarita* Murrill from the Blue Mountains, Jamaica, as redescribed by Smith (1947, p. 459). The only difference appears to lie in the spores which Smith found a little broader, 7–8 × 5–6 μ. Until more is known of the variation in spore size I hesitate to describe a new species on such slender grounds. *M. roridula* (Berk. & Curt.) Sacc. is similar but has adnate gills.

Mycena rorida (Fr.) Quélet, *Champ. Jura et Vosges*, p. 108, 1872

Agaricus roridus Fr., *Syst. Myc.* **1**, 156, 1821.

Pileus less than 1 cm. diameter, hemispherical to convex, dry, varying from brown to white, margin striate; flesh thin, white. Gills subdistant, broad, adnate to slightly decurrent, of two lengths, white. Stipe equal above a small swollen foot, up to 1 mm. thick, white, covered especially in the lower part with a thick glutinous hyaline sheath. Spores elliptic-cylindric 6–8 × 2·5–3·5 μ, strongly blue-amyloid. Pileus surface a hymenium-like layer of thin-walled pyriform cells 18–24 μ wide with grey-brown sap. Tramal hyphae broad, non-gelatinized, deep red in Melzer's reagent, clamp connexions present. Gill edge sterile, of clavate thin-walled hyaline hairs about 25–30 × 7–8 μ. No cystidia on the gill face. Stipe densely covered with undulating, cylindrical or clavate, hyaline hairs up to about 160 × 2·5–3 μ embedded in colourless mucilage. Basidia 5–6 μ wide 2–4 spored on the same gill. (Pl. 22, fig. 12.)

On dead leaves and sticks on forest floors.

Trinidad: Naranja, 27 November 1949, Dennis 380; about 1500 ft. on Cerro del Aripo, 23 October 1949, Dennis 222.

This is evidently a cosmopolitan species.

Corner (1950) has rather prematurely coined the varietal name *lamprospora* for the tropical form on the grounds that it tends to have more of the basidia 4-spored than the temperate form and consequently rather smaller spores, and that the spore print is luminous when damp and fresh in the Malayan form. He did not confirm luminescence in the Brazilian form, nor did I in the Trinidad collections, and presumably no one has looked for luminescence in spore prints of the temperate form.

Mycena pseudocrocata sp.nov.

Pileus 1 cm. latus, convexus, umbone obtuso demum subumbilicato, striatus, glaber, fulvus, in sicco ater, carne brunnea, succo rubro-brunneo; lamellae confertae, adnatae demum decurrentes, cinnamomeae; stipes cylindricus vel deorsum sensim incrassatus, –1·5 mm. crassus, fistulosus, glaber, fulvus; sporae ellipticae, biguttulatae 8 × 4 μ, amyloideae; cheilocystidia echinulata 6–14 μ diam.

Ad terram in sylvis, Mt. Periquito, Maracay, Venezuela. Dennis 344 Typus.

Pileus up to 1 cm. diameter, convex, flat or slightly depressed at the disk, smooth, tawny with darker striae; flesh dark brown, yielding reddish brown juice when broken. Gills rather crowded, of two lengths, narrow, adnate, becoming decurrent, cinnamon. Stipe equal or slightly attenuated upwards, 1–1·5 mm. thick, smooth, hollow, concolorous with the pileus above, paler below. The whole fungus dries black. Spores elliptic-cylindric, biguttulate, 8 × 4 μ, rather feebly blue-amyloid. Basidia 4-spored, about 18 × 6 μ. Cuticle of the pileus formed of more or less parallel colourless slender hyphae studded with short fine processes like those of the cystidia. Tramal hyphae about 14 μ wide with purplish contents, deep red-purple in Melzer's reagent. Lacticiferous hyphae 6–9 μ wide, undulating, with dark red-brown contents. Marginal cystidia pyriform, thin-walled, hyaline, 8–14 μ diameter, studded with short processes. No cystidia on the gill face remote from the margin. (Pl. 22, fig. 6; Text-fig. 43.)

Solitary on soil in montane forest.

Venezuela: Rancho Grande, Maracay, 19 November 1949, Dennis 344 (Typus).

Mycena pseudocorticola Kühner, *Botaniste*, **29**, 368, 1934

Pileus up to 6 mm. diameter, hemispherical, sulcate-striate, wood-brown to greyish brown, flesh thin, concolorous. Gills subdistant, white or pallid, adnate, rather broad. Stipe slender, less than 1 mm. thick, concolorous with the pileus. Spores globose 7–10 μ wide, contents yellowish and oily, blue-amyloid. Basidia large, clavate, about 20–30 × 8 μ with four long curved sterigmata. Cuticle of the pileus ill-preserved in dried material, but apparently slender hyphae with fine processes on the outer walls. Tramal hyphae 6–20 μ wide, short-celled, appearing isodiametric in tangential section, the largest cells in the subepidermis, walls hyaline, contents yellowish and granular, the walls deeply stained reddish purple in Melzer's reagent. Cystidia on the gill edge pyriform, hyaline, thin-walled, 10–12 μ wide, with long slender processes. (Text-fig. 44.)

Gregarious on bark.

Trinidad: Caura Valley 27 November 1949, Dennis 388. Jamaica: Cinchona, 19 December 1949, Dennis J 15.

Mycena sabali (Murrill) Murrill, *Mycologia*, **8**, 221, 1916

Prunulus sabali Murrill, *N. Amer. Flora*, **9**, 325, 1916.

Pileus about 1 cm. diameter, campanulate, light grey with a whitish bloom, sometimes with a yellowish tint, closely striate, darker at the umbo flesh whitish, thin, odourless. Gills moderately spaced, narrow, of two lengths, adnate, concolorous. Stipe equal, about 1 mm. thick, hollow, grey with a white pruina. Spores elliptical, 6–10 × 4–5 μ, strongly blue-amyloid. Cuticular cells broad, thin-walled and elliptical, interspersed with thin-walled hyaline hairs up to 100 × 10 μ, which form the bloom on the pileus. Cystidia similar on edge and face of gills, cylindric-fusiform pointed, 35–45 × 9–11 μ, filled with brown oily globules. Similar bodies form the pruina of the stipe. There seems to be no milk or coloured juice in this species. (Pl. 22, fig. 7; Text-fig. 45.)

On fallen leaves of the forest floor.

Trinidad: Siparia, 3 November 1949, Dennis 282; Siparia Forest Reserve, 5 November 1949, Dennis 282A.

Mycena fuliginella A. H. Smith var. **brevispora** var.nov.

A typo differt sporis ellipticis 6·5–8 × 2·75–4 μ.
Ad lignum putridum, Arena, Trinidad. Dennis 126 Typus.

Pileus up to 1·5 cm. diameter, convex, becoming flattened in age mummy-brown, shading to sepia at the margin, striate; flesh concolorous thin, fragile, hygrophanous. Gills subdistant, of two lengths, about 2 mm wide, adnate with a decurrent tooth, white. Stipe slender, equal, 1 mm thick, hollow, pallid, with a fine pruina. Spores elliptical, 6·5–8 × 2·75–4 μ blue-amyloid. Pileus surface of elliptical, thin-walled cells, 25–45 × 16–25 μ in parallel rows, filled with purplish brown sap; two or three hypoderma layers contain similar cells but the underlying trama is of more slender colourless hyphae stained brownish in Melzer's reagent. Cystidia of the gill edge numerous, fusoid-ventricose, thin-walled hyaline hairs about 40 × 9 μ, the obtuse apex about 5 μ. None on the gill face. Similar but shorter hairs about 25 × 8 μ form the pruina of the stipe. (Pl. 23, fig. 16 Text-fig. 46.)

Gregarious on rotten wood.

Trinidad: on stump in Arena Forest, 5 October 1949, Dennis 126 (Typus); on burnt bamboo, St Joseph, 18 October 1949, Dennis 126A.

Mycena translucentipes (Murrill) Smith, *N. American Species of Mycena* p. 156, 1947

Omphalopsis translucentipes Murrill, *N. Amer. Flora*, **9**, 312, 1916.

Omphalia translucentipes (Murrill) Murrill, *Mycologia*, **8**, 220, 1916.

Pileus up to 1 cm. diameter, occasionally up to 1·5 cm., convex becoming flattened at the disk, white becoming cream coloured or tinged brownish at the disk only, closely striate; flesh thin, white. Gills crowded narrow, of two lengths, adnate. Stipe equal, 1 mm. thick, hollow, white pruinose. Spores subglobose 5–5·5 × 3·5–4·5 μ, blue-amyloid. Surface o the pileus formed of more or less parallel hyphae with elongated cells

10–15 μ wide, tramal hyphae similar. Cystidia on the gill edge ventricose, thin-walled, obtuse, about 30 × 14 μ, the apex 10 μ or smaller. Hairs of the stipe cylindrical, obtuse, thin-walled, about 30–55 × 7–9 μ, constricted at the base. Basidia 4-spored, about 6 μ wide. (Text-fig. 47.)

Densely caespitose on rotting logs in forests.

Trinidad: crest of the northern range north of Arima, 25 September 1949, Dennis 55; Non Pareil, Sangre Grande, 11 October 1949, Dennis 55A.

Mycena trinitatis sp.nov.

Pileus 5 mm. latus, convexus, tenuis, sordide griseo-brunneus, margine pallidus, substriatus, carne brunnea; lamellae subremotae, adnexae, griseae, acie albae; stipes elongatus, tenuis, cylindricus, flexuosus, albus vel griseus, pruinosus; pelliculae celluli sursum verrucosi, hyalini; cystidia ventricosa, hyalina, membrana tenui, 25–30 × 5–8 μ; sporae hyalinae, guttulatae 6·5–8 × 4–5·5 μ.

Ad terram, St Augustine, Trinidad. Dennis 34 Typus.

Pileus up to 5 mm. diameter, convex, dark grey-brown, paler and obscurely striate at the margin; flesh very thin, concolorous. Gills subdistant, of two to three lengths, adnexed, light grey with white edges. Stipe equal, long and slender, undulating, less than 1 mm. thick, white to pale grey, minutely pruinose with hyaline 1-celled obtuse hairs about 10 × 3 μ. Spores ovoid, 6·5–8 × 4–5·5 μ, guttulate, non-amyloid. Basidia 4-spored, about 15 × 6 μ. Surface of the pileus a thin hyaline pellicle bearing minute processes overlying broad tubular hyphae up to 15 μ wide in the subepidermis and with grey-brown sap, more slender and hyaline in the subhymenium, non-amyloid, yellow in Melzer's reagent. Cystidia of the gill edge cylindric-ventricose, thin-walled, hyaline, 25–30 × 5- 8 μ. (Text-fig. 48.)

Solitary on bare ground (or? from buried wood).

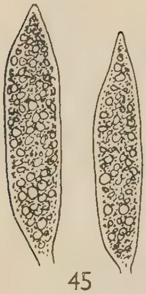
Trinidad: St Augustine, 24 September 1949, Dennis 34.

I tentatively referred this collection to *M. subcucullata* A. H. Smith, but Dr Smith has kindly advised me that he thinks the lack of cystidia on the gill face and slightly narrower cystidia on the gill edge make this identification inadvisable. *M. subcucullata* is a fungus of mossy logs in the northern U.S.A. and Canada.

Mycena parabolica (Fr.) Quélet, *Champ. Jura et Vosges*, p. 242, 1872, sensu Kauffman 1918

Agaricus parabolicus Fr., *Epicrisis*, p. 107, 1838.

Pileus 2–3 cm. diameter, conico-campanulate, sepia with darker striae; flesh dark grey, hygrophanous, fragile. Gills subdistant, about 3 mm. wide, of two lengths, grey, connected by shallow veins, adnate. Stipe equal or slightly attenuated upwards, 2–3 mm. thick, concolorous with the pileus or paler grey, minutely white-pruinose above, hollow, fragile. Spores broadly elliptical, one to two guttulate, not or very feebly amyloid, 8–10 × 6–7 μ. Basidia mostly 4-spored, 20–30 × 6–7 μ, a few 2-spored, sterigmata stout. Pileus surface apparently a thin hyaline pellicle overlying a subepidermis of broad thin-walled cells 60–100 × 30–45 μ, with grey-brown sap. Tramal hyphae broad, deep red-purple in Melzer's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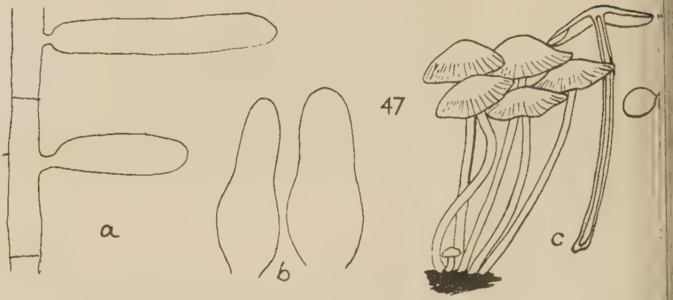

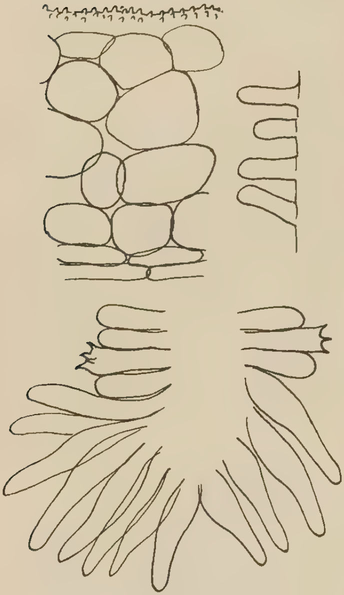
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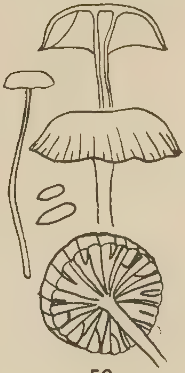
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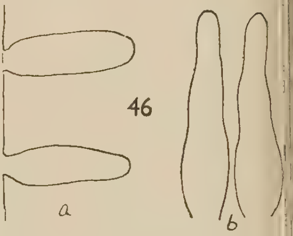

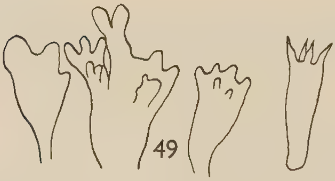
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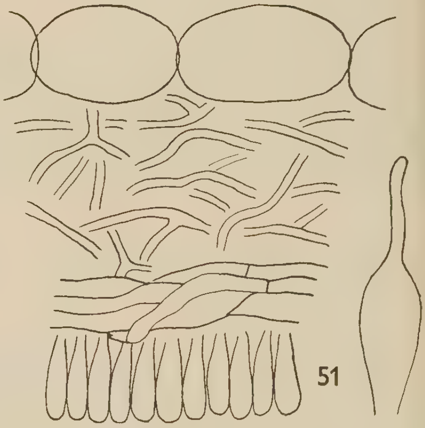
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Text-fig. 45. *Mycena sabali:* cystidia, × 660.

Text-fig. 46. *M. fuliginella* var. *brevispora:* (*a*) hairs of stipe, (*b*) of gill edge, × 660.

Text-fig. 47. *M. translucentipes:* (*a*) hairs of stipe, (*b*) of gill edge, × 660, (*c*) sporophores, × 1 and spore.

Text-fig. 48. *M. trinitatis:* above, section of pileus and hairs of stipe, below, section of gill edge, all × 660.

Text-fig. 49. *M. parabolica:* basidium, × 660. Cheilocystidia sketched from mount of fresh gill in Caracas when magnification could not be determined. They cannot be adequately recovered from the dried specimens.

Text-fig. 50. *M. serotina*, sporophore on left, × 1; section and sketches of pileus, × 4; spores, × 660.

Text-fig. 51. *M. umbilicata*, section of pileus and cystidium, × 660.

eagent. Gill edge formed of thin-walled clavate, hyaline cystidia with hort obtuse apical processes. (Pl. 23, fig. 3; Text-fig. 49.)

Caespitose on stumps in forests.

Venezuela: El Junquito, 1920 m., 16 November 1949, Dennis 356.

Mycena serotina (Peck) A. H. Smith, *North American Species of Mycena*, p. 375, 1947

Omphalia serotina Peck, *Bull. Torrey bot. Cl.* **34**, 98, 1907.

Omphalopsis serotina (Peck) Murrill, *N. Amer. Flora*, **9**, 314, 1916.

Pileus 6 mm. diameter, convex, flat at the disk, margin striate, silky, Saccardo's umber; flesh thin, dry, light grey under the brown cuticle. Gills subdistant, of two lengths, broad, adnate with a decurrent tooth, ight grey. Stipe long, slender, equal, hollow, less than 1 mm. thick, light grey-brown, smooth except for a fine down of slender wavy hairs about 20 × 1 μ just below the gills. Spores elliptic-cylindric, 5–7 × 2–3 μ, probably non-amyloid. Surface of the pileus formed of parallel thin-walled grey-brown hyphae with inflated terminal cells about 70–110 × 20–33 μ. Tramal hyphae slender, hyaline, deep wine-red in Melzer's solution. Cystidia none on face or edge of gill but a few slender hairs like those on the stipe are scattered along the gill edge. (Text-fig. 50.)

Solitary on the ground in forests.

Trinidad: Arena Forest, 30 October 1949, Dennis 260.

Though only a single sporophore was collected it appears sufficiently characterized by the small narrow spores and absence of cystidia to warrant record. The type was larger, 1–2 cm. diameter, but Smith when re-examining it found no cystidia and spores 6–8 × 2·5–3 μ.

Mycena umbilicata sp.nov.

Pileus 5 mm. latus, convexus, centro umbilicato, griseus, albostriatus, glaber, tenuis, carne alba; lamellae confertae, utrinque attenuatae, griseae; stipes tenuis, incurvus, albus, glaber, basi expansus albopruinosus; sporae ellipticae, guttulatae 5–6 × 4 μ; cheilocystidia ventricosa; pelliculae celluli ovoidei 30–45 × 25 μ.

Ad corticem truncorum putrescentium prope Arima, Trinidad. Dennis 59 Typus.

Pileus about 5 mm. diameter, slightly convex with a broad shallow umbilicus, dark grey with white striae, paler in the umbilicus, smooth, dry; flesh very thin, soft, white under the cuticle. Gills crowded, equal, attenuated at each end, horizontal, attached to the expanded apex of the stipe, light grey. Stipe slender, curved, equal, white, smooth and shining, the base slightly expanded and downy with short white hairs. Spores elliptical with a prominent lateral apiculus and a large central guttule 5–6 × 4 μ, apparently non-amyloid. Gill edge fringed with ventricose cystidia 8–10 μ wide, with long slender cylindrical beaks about 10–12 × 2–2·5 μ. Pileus surface formed by a single layer of elliptical cells 30–45 × 25 μ, overlying a trama of very loosely woven hyaline hyphae 2–3 μ thick. Subepidermis of compact brown hyphae 4–5 μ thick. (Pl. 23, fig. 9; Text-fig. 51.)

Scattered on dead trunks and on sticks in forest litter.

Trinidad: roadside 10 miles north of Arima, 25 September 1949, Dennis 59 (Typus); Mora Forest, 16 October 1949.

Marasmius discopus Massee, from Siam, is very similar but has large sporophores and spores 6–9 × 4–6 μ.

Mycena citricolor (Berk. & Curt.) Sacc., *Syll. Fung.* 5, 263, 1887

Agaricus citricolor Berk. & Curt., *J. linn. Soc.* (*Bot.*), **10**, 285, 1868.
Omphalia flavida Maubl. & Rangel, *Bull. Soc. mycol. Fr.* **30**, 46, 1914.
Omphalopsis citricolor (Berk. & Curt.) Murr., *N. Amer. Flora*, **9**, 316, 1916
Mycena flavida (Maubl. & Rangel) Singer, *Lilloa*, **22**, 357, 1951.

Pileus up to 5 mm. diameter, campanulate or hemispherical, sometime becoming slightly umbilicate, barium-yellow, smooth, sulcate-striate flesh thin, soft, concolorous. Gills distant, rather broad, of one or tw lengths, adnate or arcuate, concolorous. Stipe flexuous, up to ½ mm thick, equal, concolorous, minutely downy with unicellular, thin-walled hairs 50–80 × 7–12 μ. Spores elliptic-cylindric, hyaline, 4–5 × 2·5–3 μ iodine reaction uncertain, basidia 4-spored, cystidia wanting, gill edg fertile. Pileus surface formed of parallel, thin-walled hyphae with cell 50–110 × 15–20 μ; trama deep red-brown in Melzer's reagent. (Pl. 22, fig. 11.

On dead leaves and leaf spots of dicotyledonous plants in montan forests, associated with gemmifers, *Stilbum flavidum* Cooke, which have bee fully described by Ashby (1925) and Buller (1934).

Collections seen.—Cuba: Wright 15 (Typus of *Ag. citricolor*, *Stilbum* state associated). Guatemala: on coffee, Herb. Cooke. Costa Rica: San Jose, 20 January 1939, on coffee, photographs from Señor F. C. Barahon in Herb. C.M.I. Jamaica: on creeping herb, west slope of High Peak, Blu Mountains, 22 December 1949, Dennis J43. Puerto Rico: culture o gemmifers on malt agar C.M.I. 34639, 6 June 1928, and 34638, 5 Jul 1928. Trinidad: on unidentified fallen leaves, crest of northern range north of Arima 1800 ft., 25 September 1949, Dennis 69; Ortinola 8 October 1949, isolated from spots on coffee leaves and mature sporophore obtained on malt agar.

Mycena osmundicola Lange, *Dansk bot. Ark.* **1** (5), 35, 1914

This species is too well known to warrant redescription (Text-fig. 52).

Trinidad: Arena Forest, 5 October 1949, Dennis 127. Venezuela El Junquito 1920 m., 16 November 1949, Dennis 127V.

Dennis 402 from Rancho Grande, Venezuela, differs only in the sphaerocysts containing grey-brown sap. I suspect *Marasmius pruinosus* Fr. described from one of Oersted's sketches made at Naranjo, Costa Rica was this species, but one can scarcely feel certain of its identity as no specimens were preserved.

Mycena theobromicola (Murrill) comb.nov.

Marasmius theobromicola Murrill, *N. Amer. Flora*, **9**, 255, 1915.

Pileus 1 cm. diameter, campanulate, flat at the disk, striate at th margin, smooth, white; flesh very brittle, thin, white. Gills subdistant equal, broad, adnate with a decurrent tooth, white. Stipe equal, solid about ½ mm. thick, white, wine-red in Melzer's reagent. Spores tear shaped to oval, non-amyloid, 6–9 × 3·5–5 μ. Basidia 2-spored 15 × 4 μ terigmata stout, 5 μ long. Pileus surface formed of elliptical thin-walled ells, radially elongated, 35–70 × 27–40 μ, with a more or less nodulose urface; trama only slightly reddish brown in Melzer's reagent. Gill edge pparently sterile, with very small clavate cells covered with minute rocesses. (Text-fig. 53.)

In small clusters on rotten cacao pods.

Collections seen.—Grenada, St George's, September 1905, W. E. roadway (Typus). Trinidad: River Estate, Diego Martin, 29 September 949, Dennis 102.

Marasmius praedecurrens Murrill, on soil amongst debris, Bermuda, is very imilar but has 4-spored basidia.

ycena micropapillata sp.nov.

Pileus 5–8 mm. latus, tenuis, obconicus, margine sulcato-striatus, umbone minuto, laber, albus, carne alba; lamellae remotae, decurrentes, albae; stipes cylindricus, ·5 mm. crassus, albus, pruinosus; sporae ellipticae, hyalinae, 5–7 × 2–2·5 μ; cheiloystidia cylindrica 20–30 × 5–6 μ.

Ad folia dejecta Theobromatis, Diego Martin, Trinidad. Dennis 96 Typus.

Pileus 5–8 mm. diameter, obconical, sulcate-striate at the margin, sually slightly depressed round the minute papillate umbo, smooth, pure hite; flesh thin, white, brittle. Gills distant, equal, broad, deeply ecurrent, white. Stipe equal, about ½ mm. thick, soft, white, covered ith cylindrical thin-walled hyaline hairs up to 50 × 5 μ. Spores elliptic-ylindric, 5–7 × 2–2·5 μ, apparently non-amyloid. Pileus surface of more r less parallel hyphae 8–11 μ broad, the cells 25–40 μ long. Trama eddish brown in Melzer's reagent. Gill edge fringed with delicate thin-alled cylindrical or irregular cystidia 5–6 μ wide, protruding 20–30 μ. Text-fig. 54.)

In small groups on or near the veins of rotting *Cacao* and other leaves in lantation litter.

Trinidad: River Estate, Diego Martin, 29 September 1949, Dennis 96.

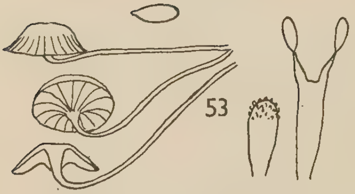
ycena marbleae (Murrill) comb.nov.

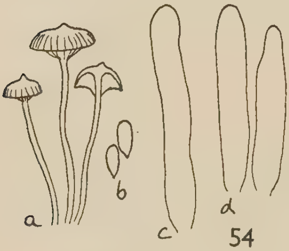
Marasmius marbleae Murrill, *N. Amer. Flora*, **9**, 255, 1915.

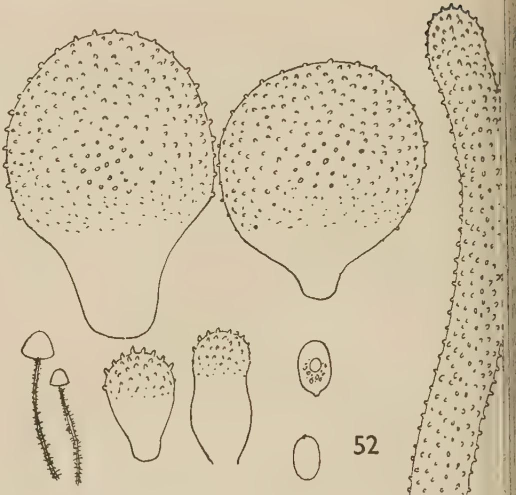
Pileus up to 5 mm. diameter, hemispherical, smooth, dry, white, faintly ellucidly striate; flesh very thin, white. Gills distant, of two lengths, road, adnate, white. Stipe short, curved, equal, less than 1 mm. thick, hite, minutely downy with slender short hairs once or twice forked, bout 10–15 × 2–3 μ. Spores elliptical, non-amyloid, 8–9 × 4 μ. Cystidia on he gill face cylindrical 4–5 μ wide with narrow pointed beaks. Surface of he pileus formed of two to three layers of elliptical, thin-walled cells 0–66 × 25–30 μ. Subhymenium and gill trama of slender hyphae. (Text-ig. 55.)

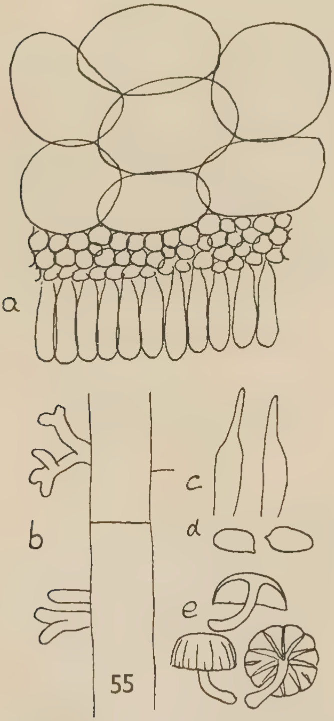
In swarms on woody debris.

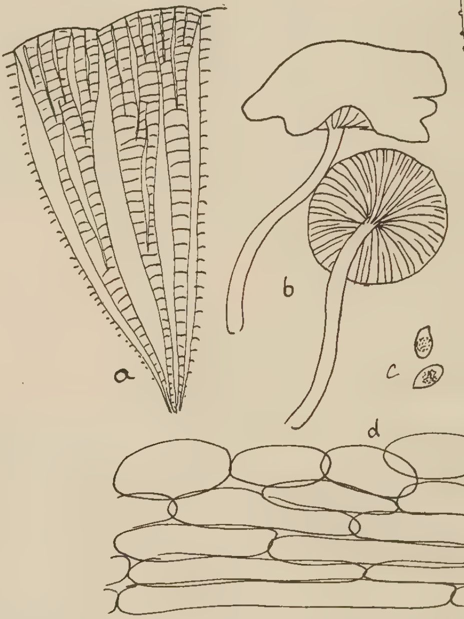
Collections seen.—Jamaica: on sticks, Cockpit Country, September 1906, . G. Britton and D. W. Marble 340 (Typus). Trinidad: on rotting *Cacao* od, Aripo trace *c.* 1000 ft., 23 October 1949, Dennis 228.











Text-fig. 52. *Mycena osmundicola:* drawn from Dennis 127V. Above, sphaerocysts from pileus below, sporophores natural size, cystidia and spores; on right hair of the stipe, ×660.

Text-fig. 53. *M. theobromicola:* sporophores, natural size; spore cheilocystidium and basidium ×660.

Text-fig. 54. *M. micropapillata:* (*a*) sporophores, natural size; (*b*) spores; (*c*) hair from the stipe (*d*) cheilocystidia; all ×660.

Text-fig. 55. *M. marbleae:* (*a*) tangential section of pileus; (*b*) hairs of stipe; (*c*) cheilocystidia (*d*) spores; all ×660; (*e*) sporophores, natural size.

Text-fig. 56. *Dictyoploca tessellata:* (*a*) plan of gills, ×3; (*b*) sporophores, natural size; (*c*) spores ×660; (*d*) radial section of pileus, ×330.

DICTYOPLOCA (Mont.) Heim, *Rev. mycol.* (N.S.) **10**, 14, 1945

Dictyoploca was erected by Montagne (1854) as a tentative subgenus of *Iarasmius* and was founded on *M. plectophyllus* Mont. Heim raised it to eneric rank, apparently without studying the type, and characterized it s having interveined gills and non-amyloid spores. Similar species with myloid spores he assigned to a new genus *Phlebomycena* Heim. Material interpret as *Marasmius plectophyllus* Mont. has amyloid spores but it is vident that the iodine reaction of the spore wall is not of generic significance in the Collybia-Mycena series.

Metrod (1949) reduced *Dictyoploca* to a subgenus of *Mycena*, an attitude ith which it is easy to sympathize, for interveined gills clearly have little axonomic value. However, the West Indian species referable to it form compact and easily recognized group, and I am accordingly retaining *ictyoploca* as a genus for the purposes of this paper.

Spores non-amyloid:	
A. Pileus grey-brown.	*D. guadelupensis*
B. Pileus bright yellow.	*D. rhyssophylla*
C. Pileus white.	*D. tessellata*
I. Spores strongly amyloid:	
A. Pileus purple.	*D. holoporphyra*
B. Pileus grey-brown.	*D. plectophylla* var. *umbrina*
C. Pileus white or cream:	
a. Pileus over 1 cm. diameter, gill edge fertile.	*D. plectophylla*
b. Pileus less than 1 cm. diameter, gill edge sterile.	see *Micromphale*

ictyoploca guadelupensis Heim, *Rev. mycol.* (N.S.), **10**, 20, 1945

Pileus up to 3 cm. diameter, convex, becoming somewhat flattened but ith a small central umbilicus, sulcate-striate and reticulately furrowed, uffy-brown; flesh thin, white under the cuticle, flexible. Gills distant, of hree series, closely and reticulately interveined, slightly decurrent, hitish. Stipe short, slightly enlarged at base and apex, tubular, about mm. thick, smooth, paler than the pileus. Spores obovoid, 5–7 × 4 μ, rint white, non-amyloid. Pileus surface formed of thin-walled hyphae –5 μ diameter with grey-brown sap, trama of broader, hyaline hyphae. ill edge sterile with thin-walled, somewhat ventricose hairs, about 0–30 × 8 μ. (Pl. 22, fig. 21.)

On logs in forests.

Trinidad, Arena Forest, 30 October 1949, Dennis 262.

ictyoploca rhyssophylla (Mont.) Baker & Dale, *Mycol. Pap. Commonw. Iycol. Inst.* **33**, 1951

Marasmius rhyssophyllus Mont. apud Berk., *J. linn. Soc.* (*Bot.*), **10**, 294, 869.

Pileus up to 3 cm. diameter, convex, often somewhat umbilicate at the entre, light cadmium to lemon-chrome; flesh light yellow, thin. Gills ather crowded, of three to four lengths, narrow, slightly decurrent, losely and reticulately interveined, concolorous. Stipe slightly enlarged t base and apex, 2–3 mm. thick, hollow, smooth, concolorous. Spores elliptical, non-amyloid, 6–8 × 4–4·5 μ. Pileus surface formed of radiating hyphae 5–6 μ wide, their terminal cells often swollen to 30 × 12-13 μ. Trama non-amyloid. Gill edge sterile, covered with thin-walled, irregular vesicular hairs about 40 × 15 μ. (Pl. 22, fig. 15.)

Caespitose on logs.

Collections seen.—Trinidad: Cerro del Aripo 18 June 1947, R. E. D Baker 1466; roadside forest north of Erin, 6 November 1949, Dennis 303;

D. heterophylla Heim from Guadeloupe is a probable synonym.

Dictyoploca tessellata (Mont.) comb.nov.

Marasmius tesselatus Mont., *Ann. Sci. Nat.* (*Bot.*), Ser. 4, **1**, 116, 1854
Marasmius albofuscus Berk. & Curt., *J. linn. Soc.* (*Bot.*), **10**, 295, 1868
Omphalopsis cuticolor Murrill, *N. Amer. Flora*, **9**, 317, 1916.

Pileus up to 3 cm. diameter, convex, margin undulating or lobed smooth, white or pale cream, margin faintly pellucidly striate; flesh thin white. Gills rather crowded, of about four lengths, irregular, closely and reticulately interveined, shortly decurrent, white. Stipe equal, flexuous about 2 mm. thick, smooth, white. Spores elliptical, non-amyloid 5·5 × 3 μ, often with a central oil body. Pileus surface formed of elliptical cells 30–70 × 24–40 μ overlying a trama of broad, thin-walled, hyalin hyphae. Cystidia apparently absent. (Text-fig. 56.)

On dead wood in montane forest.

Collections seen.—French Guiana: Leprieur 1044 (Herb. Montagne Paris, Typus). Trinidad: beside Tucuche trail on Naranja, about 2000 ft. 2 October 1949, Dennis 119. Cuba: Wright 87 (Typus of *Marasmiu albofuscus* in Herb. Berkeley). Mexico: Motzorongo, Cordoba, 15 Januar 1910, Murrill 1014 (Typus of *Omphalopsis cuticolor*).

The spores of Murrill 1014 are possibly very feebly amyloid. Dennis 70 on logs, 25 September 1949, is similar but burnt sienna throughout. Th collection unfortunately proved sterile but it possibly represents a furthe species of *Dictyoploca*.

Dictyoploca plectophylla (Mont.) comb.nov.

Marasmius plectophyllus Mont., *Ann. Sci. Nat.* (*Bot.*) Ser. 4, **1**, 111, 1854
Collybia plectophylla (Mont.) Singer, *Lilloa*, **22**, 200, 1951.

Pileus 2–2·5 cm. diameter, convex with a small umbilicus, cartridge-buff smooth, sulcate-striate; flesh thin, white. Gills subdistant, of two lengths conspicuously interveined, adnate with a decurrent tooth, white. Stip equal, 2–3 mm. thick, smooth, hollow, concolorous with the pileus. Spore elliptic-cylindric, 6–7 × 3–3·5 μ with a large oil drop, print white, strongl blue-amyloid. Basidia clavate, 4-spored, about 20 × 5 μ. Gill edg apparently fertile, cystidia wanting. Trama deep wine-red in Melzer reagent. (Text-fig. 57.)

On litter in forests.

Trinidad: Siparia, 3 November 1949, Dennis 285.

Montagne included in *M. plectophyllus* four collections, Leprieure 104 1046, 1047 and 1048, described respectively as 'pileo dilute grise violaceo', 'albo-rubello', 'violaceo-vinoso' and 'pallide vinoso', but th

rm figured in the same paper as the diagnosis was whitish with a yellowish ipe. Hence I have taken the above light-coloured form as typical and ssigned a varietal name to the brown forms. The purple form is probably hat Berkeley & Curtis, later described as *Clitocybe holoporphyra*.

ar. **umbrina** var.nov.

A typo differt pileo umbrino.
Ad terram, St Joseph, Trinidad. Dennis 189 Typus.

Differs from the type only in the pileus and stipe being buffy-brown. he pileus surface is formed of broad, more or less parallel hyphae, with ells about 70–110 × 30–35 μ. (Pl. 22, fig. 17.)

Trinidad: bamboo plantation, St Joseph, 18 October 1949, Dennis 189 Typus).

ictyoploca holoporphyra (Berk. & Curt.) comb.nov.

Agaricus holoporphyrus Berk. & Curt., *J. linn. Soc.* (*Bot.*), **10**, 284, 1868.
Clitocybe holoporphyra (Berk. & Curt.) Sacc., *Syll. Fung.* **10**, 196, 1887.
Melanoleuca holoporphyra (Berk. & Curt.) Murrill, *N. Amer. Flora*, **9**, 31, 916.

Pileus up to 5 cm. diameter, convex with a small umbo, then somewhat attened, sulcate-striate and transversely reticulately furrowed, vinaceous-lac; flesh thin, concolorous. Gills subdistant, of several lengths, rather road, thin, closely connected by shallow veins, paler than the pileus. tipe equal or slightly attenuated upwards, smooth, 2–3 mm. thick, hollow, oncolorous, becoming yellowish at the base. Spores elliptic-cylindric, 5–10 × 4 μ, deeply blue-amyloid, print white. Cystidia wanting. Pileus urface and trama of broad, thin-walled hyphae, deep red-brown in Ielzer's reagent. (Pl. 22, fig. 16.)

Gregarious on rotten wood in forests.

Collections seen.—Cuba: rotten logs in woods, Wright No. 5 in Herb. erk. with collector's description and spore print. Trinidad: Siparia orest Reserve, 5 November 1949, Dennis 270A.

Possibly this, too, is only a form of *Dictyoploca plectophylla*.

TRICHOLOMOPSIS Singer, *Schweiz. Z. Pilzkunde*, **17**, 56, 1939.

Type species: *Ag. rutilans* Schaeff. ex Fr.

This is a segregate from *Tricholoma* erected for a well-defined group of ecies characterized by downy pileus and stipe, large marginal cystidia nd subglobose non-amyloid spores. It is, perhaps, too much akin to *erula* R. Maire, 1933, based on *Ag. longipes* Bull. ex Fr.

richolomopsis tropica sp.nov.

Pileus 3 cm. latus, convexus, centro depressus, flavus, velutinus, rimoso-squamulosus, rne bubalina, inodora; lamellae confertae, sinuato-adnatae, cinnamomeo-bubalinae, ie obtusae velutinae; stipes cylindricus, flavus, velutino-squamulosus, fistulosus; sporae obosae, guttulatae 4·5–5·5 μ diam.; cheilocystidia ovoidea 10–25 μ diam.
Ad terram in sylvis, Siparia, Trinidad. Dennis 283 Typus.

Pileus about 3 cm. diameter, convex, depressed at the disk, light yellow ith a short velvety pile of tawny erect hairs, cracked into minute

squamules; flesh thin, pinkish buff in the pileus, clay-coloured in the stip tasteless, odourless. Gills crowded, of two lengths, rather narrow, sinuat adnate, cinnamon-buff, edge obtuse, paler, minutely downy. Stipe equa light yellow with scurfy patches of hairs like the pileus, hollow, 4–5 mm thick. Spores globose, with a large oil drop, 4·5–5·5 μ diameter, pri white, non-amyloid. Pileus surface covered with erect, rather stiff, septa hairs 100 μ or more long and 4–7 μ thick, with brown walls, tramal hyph thin-walled, loose in the upper layers of the pileus, closely woven in th lower part and in the gills. Hymenium permeated by numerous undulatin refractive gloeocystidia, 5–6 μ wide. Gill edge formed of pyriform bladder-like thin-walled hairs 10–25 μ across, containing numerous sma oil drops. (Pl. 23, fig. 13; Text-fig. 58.)

Solitary on sandy soil in forest.

Trinidad, Siparia, 3 November 1949, Dennis 283 (Typus).

The species is evidently akin to *Tricholomopsis ornata* var. *sulfureoia* (Peck) Singer, but has smaller spores and cystidia.

TRICHOLOMA (Fr.) Kummer, *Führer Pilzk.* **25**, 129, 1871

There is no general agreement among mycologists as to the type speci of *Tricholoma*. The genus is here used for fleshy species with stout, usuall solid stipes and more or less sinuate gills.

A. Pileus cuticle hymeniform, spores amyloid. (Subgenus *Dermoloma* Lang
  1. Cystidia absent. *T. atrobrunne*
  2. Cystidia present. *T. grise*

B. Pileus surface of parallel or woven hyphae, spores non-amyloid:
  1. Surface fibrillosely scaly, cystidia on gill face. *T. naranjan*
  2. Surface not scaly, cystidia wanting:
    a. Pileus violet, less than 1 cm. across. *T. microspor*
    b. Pileus brownish or drab-coloured, larger:
      * Stipe slender, smooth. *T. rimosoi*
      ** Stipe stout, scaly. *T. pachyme*

Of *Tricholoma pachymeres* (Berk. & Br.) Sacc. I have seen only a wate colour and specimen collected by Prof. Baker and described by him Baker & Dale (1951). The remaining species are described below.

A. *Pileus cuticle hymeniform*

Tricholoma atrobrunneum sp.nov.

Pileus 4 cm. latus, umbonatus, glaber, atrobrunneus, carne alba; lamellae confert adnatae vel denticulo-subdecurrentes, griseae; stipes sordide brunneus, fibrillosus, ap incrassatus; sporae subglobatae 5·5 × 4 μ, amyloideae; pelliculae celluli ovoideo-rotund 15–20 μ diam.

Ad terram in sylvis, St Joseph, Trinidad. Dennis 8 Typus.

Pileus up to 4 cm. diameter, expanded with a broad low umbo, smoo dry, almost black; flesh thin, thick at the disk, white under the cutic flavourless. Gills rather crowded, of three lengths, adnate or sligh decurrent with a tooth, light grey, narrow. Stipe 7 mm. thick, taperi downwards, solid, whitish, streaked with longitudinal dark brown fibr Spores subglobose, about 5·5 × 4 μ, blue-amyloid. Basidia 4-spored, abc o × 5 μ. Cystidia wanting, gill edge fertile. Pileus surface formed of olourless pyriform cells 15–20 μ wide. Subepidermis of closely woven yphae about 3 μ thick, with thin dark brown walls, tramal hyphae about μ wide, colourless, compact, with clamp connexions, non-amyloid, on-gelatinized. (Pl. 23, fig. 6; Text-fig. 59.)

Solitary on the ground in bamboo plantation.

St Joseph, Trinidad, 29 September 1949, Dennis 8.

richoloma griseum sp.nov.

Pileus 6 cm. latus, expansus, subumbonatus, striatus, avellaneus, carne alba, odore rinae; lamellae latissimae, subremotae, sinuato-adnatae, albae; stipes fusiformis, fibrillosus, apice furfuraceus, albus; sporae ellipticae, amyloideae, guttulatae, 7–8 × 5–5·5 μ; leurocystidia ventricosa 50 × 10–15 μ; pelliculae celluli ovoidei, erecti.

In sylvis herbosis, Siparia, Trinidad. Dennis 293 Typus.

Pileus up to 6 cm. diameter, expanded, becoming depressed around the hallow umbo, faintly striate, dry, drab with a fine bloom; flesh thin, thick t the disk, white, tasteless, smell mealy. Gills subdistant, of two lengths, road, sinuate-adnexed, white. Stipe up to 7 mm. thick, equal or slightly usiform, fibrous, scurfy at the apex, white or tinged drab at the base, olid. Spores elliptic-cylindric, 7–8 × 5–5·5 μ, with an oil drop, print white, lue-amyloid. Basidia 4-spored, about 20 × 5 μ. Pileus surface formed of single layer of thin-walled cylindrical cells, tramal hyphae colourless, hin-walled 5–6 μ wide, compact. Cystidia abundant on the gill face, entricose, thin-walled about 50 × 10–15 μ, broadly rounded at the tip, vithout any crystals. Gill edge fertile. (Pl. 23, fig. 2; Text-fig. 60.)

Solitary amongst grass under trees.

Trinidad: Siparia Forest Bungalow, 5 November 1949, Dennis 293.

B. *Spores non-amyloid, pileus cuticle hyphal*

α. *Pileus surface fibrillosely scaly*

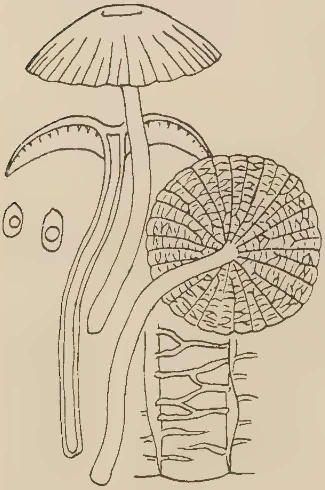
richoloma naranjanum sp.nov.

Pileus 4 cm. latus, convexus, umbonatus, avellaneus, minute adpresseque fusco-aculatus vel sub-squamulosus, carne alba; lamellae remotae, sinuatae, latissimae, emeae; stipes fibrillosus, avellaneus, apice incrassatus, farctus; sporae ellipticae, yalinae, 7–9 × 5–6·5 μ; pleurocystidia ventricosa, hyalina 70–80 × 17–20 μ.

Ad terram in sylvis, Naranja, Trinidad. Dennis 386 Typus.

Pileus about 4 cm. diameter, convex with a broad umbo, drab, shading fuscous at the umbo, covered with fuscous innate fibrils and obscurely aly; flesh thin, white with a grey line at the base of the gills. Gills distant, f three lengths, slightly sinuate, cream coloured. Stipe slightly attenuated pwards, fibrous, stuffed with loose white hyphae, drab, 5–6 mm. thick. pores broadly elliptical, 7–9 × 5–6·5 μ, print white, non-amyloid. Basidia -spored about 40 × 8 μ. Pileus surface formed of loosely adpressed brown yphae about 13 μ wide, sparsely septate; trama of similar colourless ompact hyphae. Gill face studded with thin-walled, ventricose, colourless ystidia about 70–80 × 17–20 μ, few or none on the gill edge. (Pl. 23, fig. 4; ext-fig. 61.)

Solitary on bare soil in forests.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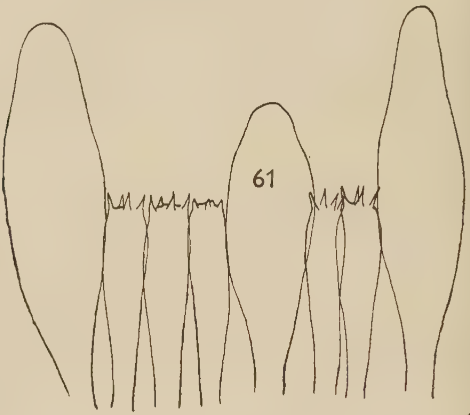
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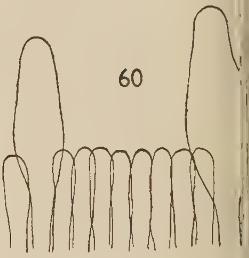
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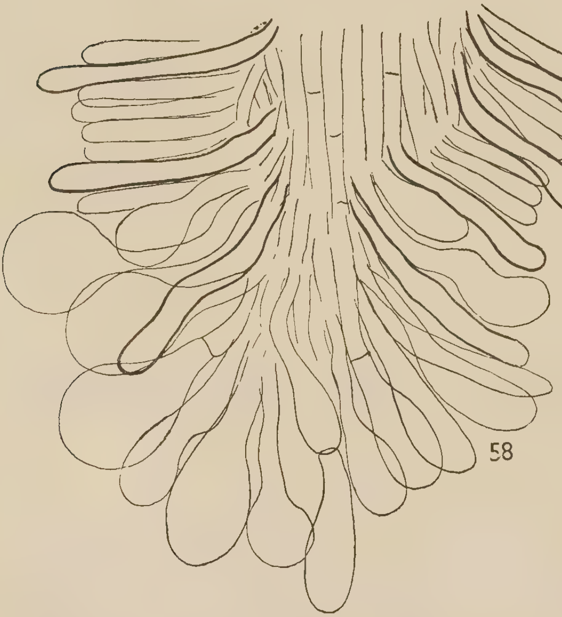
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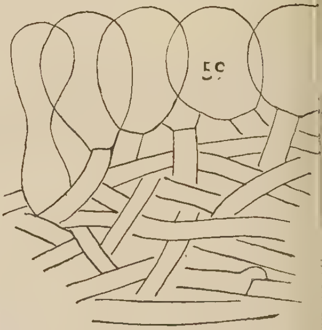
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Text-fig. 57. *Dictyoploca plectophylla:* sporophores, × 1; sketch of interveining between margi
portion of two gills, × 5; spores, × 660.
Text-fig. 58. *Tricholomopsis tropica:* section of gill edge, × 660.
Text-fig. 59. *Tricholoma atrobrunneum:* section of pileus cuticle, × 660.
Text-fig. 60. *T. griseum:* section of hymenium, × 660.
Text-fig. 61. *T. naranjanum:* section of hymenium, × 660.

Trinidad: Tucuche trail on Naranja, 27 November 1949, Dennis 386 Typus).

β. Pileus surface not scaly

richoloma rimosoides sp.nov.

Pileus 2 cm. latus, umbonatus, glaber, sericeus, avellaneus, carne grisea; lamellae ubremotae, latissimae, albescentes, sinuato-adnatae; stipes cylindricus, cartilagineus, rctus; sporae ellipticae 8–10 × 4·5–5 μ.

Ad terram in sylvis, St Joseph, Trinidad. Dennis 211 Typus.

Pileus up to 2 cm. diameter, expanded with a low umbo, smooth, silky, ght drab to avellaneous; flesh thin, light grey. Gills subdistant, of two engths, rather broad, whitish, sinuato-adnate. Stipe equal, surface somevhat cartilaginous, stuffed with white hyphae, about 2 mm. thick. Spores lliptic-cylindric, 8–10 × 4–5·5 μ, basidia 4-spored, gill edge fertile, cystidia vanting. Pileus surface formed of radiating sparsely septate hyphae –10 μ wide. Trama non-amyloid, of similar woven hyphae. (Pl. 23, fig. 12.)

Solitary on the ground.

Collections seen.—Trinidad: Bamboo plantation, St Joseph, 20 October 949, Dennis 211 (Typus); St Augustine, 27 April 1947, R. E. D. Baker 439.

This rather featureless little fungus recalls the description of *T. rimosa* eck from New York, but that had a hollow stipe, and I hesitate to assume hem to be identical.

richoloma microsporum (Ellis) Sacc., *Syll Fung.* **5**, 111, 1887

Agaricus microsporus Ellis, *Bull. Torrey bot. Cl.* **5**, 45, 1874.
Prunulus syringeus Murrill, *N. Amer. Flora*, **9**, 341, 1916.
Mycena syringea (Murrill) Murrill, *Mycologia*, **8**, 221, 1916.
Lepiota microspora (Ellis) Singer, *Lloydia*, **5**, 132, 1942.

Pileus up to 10 mm. wide, conical with a rounded umbo, dry, aconiteiolet; flesh rather thick at the disk, white under the cuticle. Gills subistant, of two to three lengths, broad, emarginate, paler than the pileus. tipe slender, about 1 mm. thick, hollow, somewhat rooting, lilac above, hading to yellowish brown below, smooth. Spores elliptical, with an oil rop, about 3 × 2 μ, hyaline, non-amyloid. Basidia 4-spored, about 8 μ iameter. Gill edge fertile, cystidia wanting. Pileus surface of closely voven hyphae 7–14 μ wide. Clamp connexions not seen. (Pl. 22, fig. 10.)

Solitary on litter in plantations and forests.

Collections seen.—Trinidad: St Joseph, bamboo plantation, 18 October 949, Dennis 187; about 2000 ft. on Cerro del Aripo, 23 October 1949, ennis 187A.

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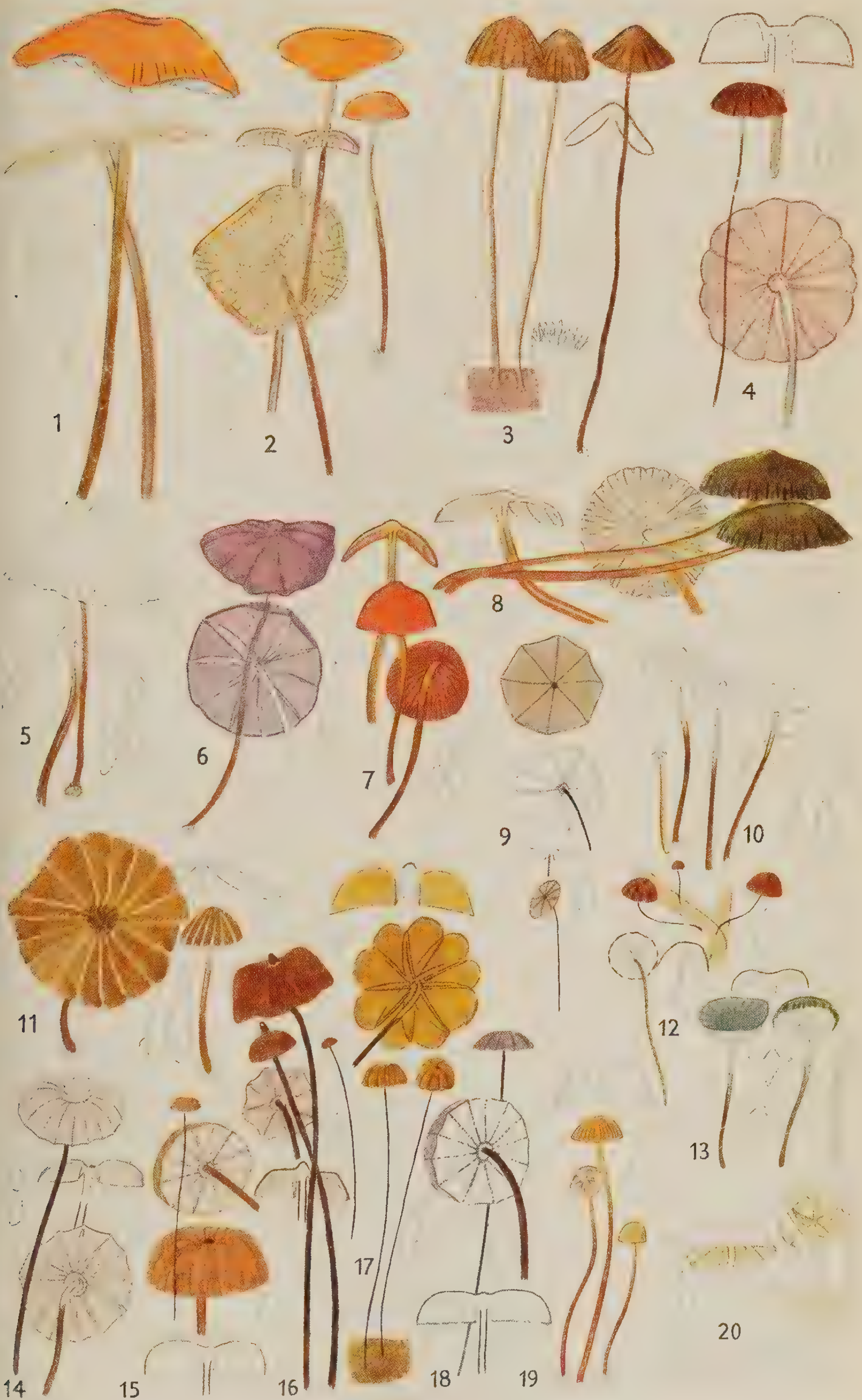
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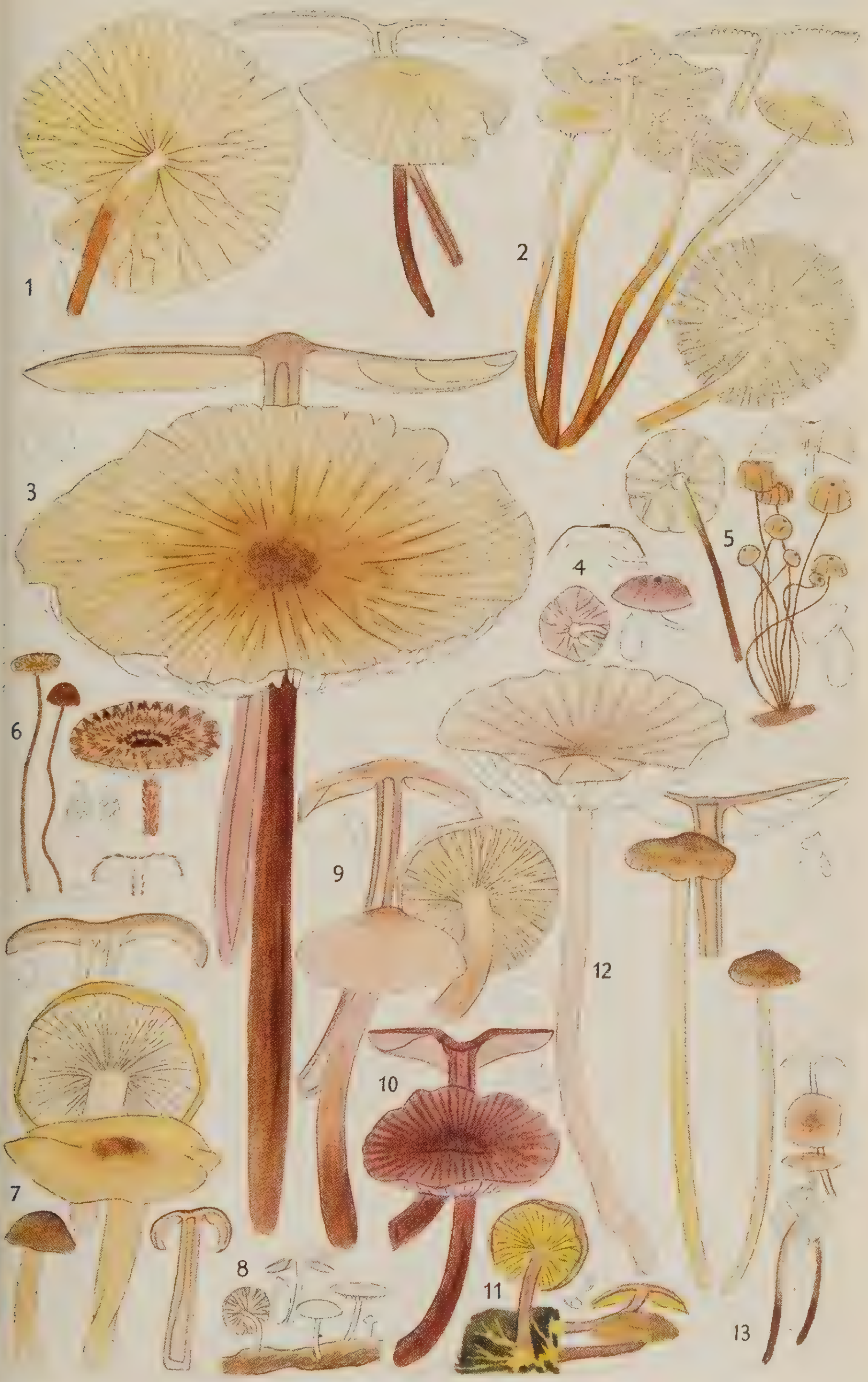
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EXPLANATION OF PLATES 19–23

Plate 19

ig. 1. *Marasmius leoninus:* spores, × 660.
ig. 2. *M. polyporoides:* spores, × 660.
ig. 3. *M. ferrugineus:* spore, cystide with short processes and cystidium, × 660.
ig. 4. *M. rubromarginatus:* details and section, × 2; spores, × 660.
ig. 5. *M. haedinus:* spores, × 660.
ig. 6. *M. tageticolor:* spore, × 660.
ig. 7. *M. haematocephalus:* spores, × 660.
ig. 8. *M. trinitatis:* spores, × 660.
ig. 9. *M. peckii:* details, × 2; spore, × 660.
ig. 10. *M. haedinus* var. *minor:* spores, × 660.
ig. 11. *M. helvolus:* spores, × 660.
ig. 12. *M. pruinatus:* spore, × 660.
ig. 13. *M. nigripes:* spores, × 660.
ig. 14. *M. rotuloides:* spores, × 660.
ig. 15. *M. graminum* var. *brevispora:* details, × 4; spore, × 660.
ig. 16. *M. trichorhizus* var. *aripoensis:* × 4; single sporophore, natural size, on right; spore, × 660.
ig. 17. *M. guyanensis:* details, × 4; spores, × 660.
ig. 18. *M. griseoviolaceus* details, × 2; spore, × 660.
ig. 19. *M. actinopus:* section, × 2; spore, × 660.
ig. 20. *M. pseudo-arachnoideus:* × 3; spore, × 660.

Plate 20

ig. 1. *Collybia nivea:* spores, × 660.
ig. 2. *C. nivea* var. *cohortalis:* spores, × 660.
ig. 3. *C. polygramma:* spores, × 660.
ig. 4. *Crinipellis perniciosus:* × 660.
ig. 5. *Marasmius aciculaeformis:* details, × 2; spores, × 660.
ig. 6. *Crinipellis septotricha:* details, × 3; spores, × 660.
ig. 7. *Collybia anthracophila:* spore, × 660.
ig. 8. *C. dealbata:* spore, × 660.
ig. 9. *C. fibrosipes:* spores, × 660.
ig. 10. *C. sericipes:* spores, × 660.
ig. 11. *C. luteo-olivacea:* spores, × 660.
ig. 12. *C. brasiliensis:* spores, × 660.
ig. 13. *Marasmius subingratus:* spores, × 660.

Plate 21

ig. 1. *Collybia cavipes:* spores and cystidium, × 660.
ig. 2. *C. subpruinosa:* spore, × 660.
ig. 3. *C. colorea:* spores, × 660.
ig. 4. *C. setulosipes:* spores, × 660.
ig. 5. *C. trinitatis:* spore, × 660.
ig. 6. *C. brunneosetosa:* spores, × 660.
ig. 7. *C. cycadicola:* spores, × 660.
ig. 8. *C. dryophila:* spore, × 660.
ig. 9. *C. johnstoni:* large form from Rancho Grande, spores, × 660.
ig. 10. *C. omphalodes:* spores, × 660.
ig. 11. *C. hirtella:* spores, × 660.

Plate 22

ig. 1. *Collybia brunneoumbonata:* spores, × 660.
ig. 2. *C. pilosa:* spore, × 660.
ig. 3. *C. coracicolor:* spores, × 660.
ig. 4. *Crinipellis rubidus:* spores, × 660.
ig. 5. *Collybia erinensis:* spores, × 660.
ig. 6. *Mycena pseudocrocata:* spore, × 660.
ig. 7. *Mycena sabali:* spores, × 660.
ig. 8. *Micromphale lutea:* spores, × 660.
ig. 9. *Collybia johnstoni:* typical form from Trinidad, spores, × 660.
ig. 10. *Tricholoma microsporum:* spores, × 660.
ig. 11. *Mycena citricolor:* details, × 3; spore, × 660.
ig. 12. *M. rorida:* on left sporophore and section, × 2; spore, × 660.
ig. 13. *Micromphale irrorata:* spores, × 660.

Fig. 14. *Collybia mycenoides:* spores, × 660.
Fig. 15. *Dictyoploca rhyssophylla:* spores, × 660.
Fig. 16. *D. holoporphyra:* spores, × 660.
Fig. 17. *D. plectophylla* var. *umbrina:* spores, × 660.
Fig. 18. *Micromphale roriduliformis;* spores, × 660.
Fig. 19. *Collybia purpurea:* spores, × 660.
Fig. 20. *C. troyana:* spores, × 660.
Fig. 21. *Dictyoploca guadelupensis:* spores, × 660.

PLATE 23

Fig. 1. *Micromphale rheicolor:* spores, × 660.
Fig. 2. *Tricholoma griseum:* spores, × 660.
Fig. 3. *Mycena parabolica:* spores, × 660.
Fig. 4. *Tricholoma naranjanum:* spores × 660.
Fig. 5. *Marasmius arimana:* sporophore, × 2; details, × 4.
Fig. 6. *Tricholoma atrobrunneum:* spores, × 660.
Fig. 7. *Marasmius cystidiophorus:* spore, × 660.
Fig. 8. *Collybia subfumosa:* spore, × 660.
Fig. 9. *Mycena umbilicata:* spore, × 660.
Fig. 10. *M. margarita:* spores, × 660.
Fig. 11. *Micromphale convexa:* spores, × 660.
Fig. 12. *Tricholoma rimosoides:* spores, × 660.
Fig. 13. *Tricholomopsis tropica:* spore, × 660.
Fig. 14. *Collybia subcoracina:* spore, × 660.
Fig. 15. *C. cinnamomea:* spores, × 660.
Fig. 16. *Mycena fuliginella* var. *brevispora:* spores, × 660.

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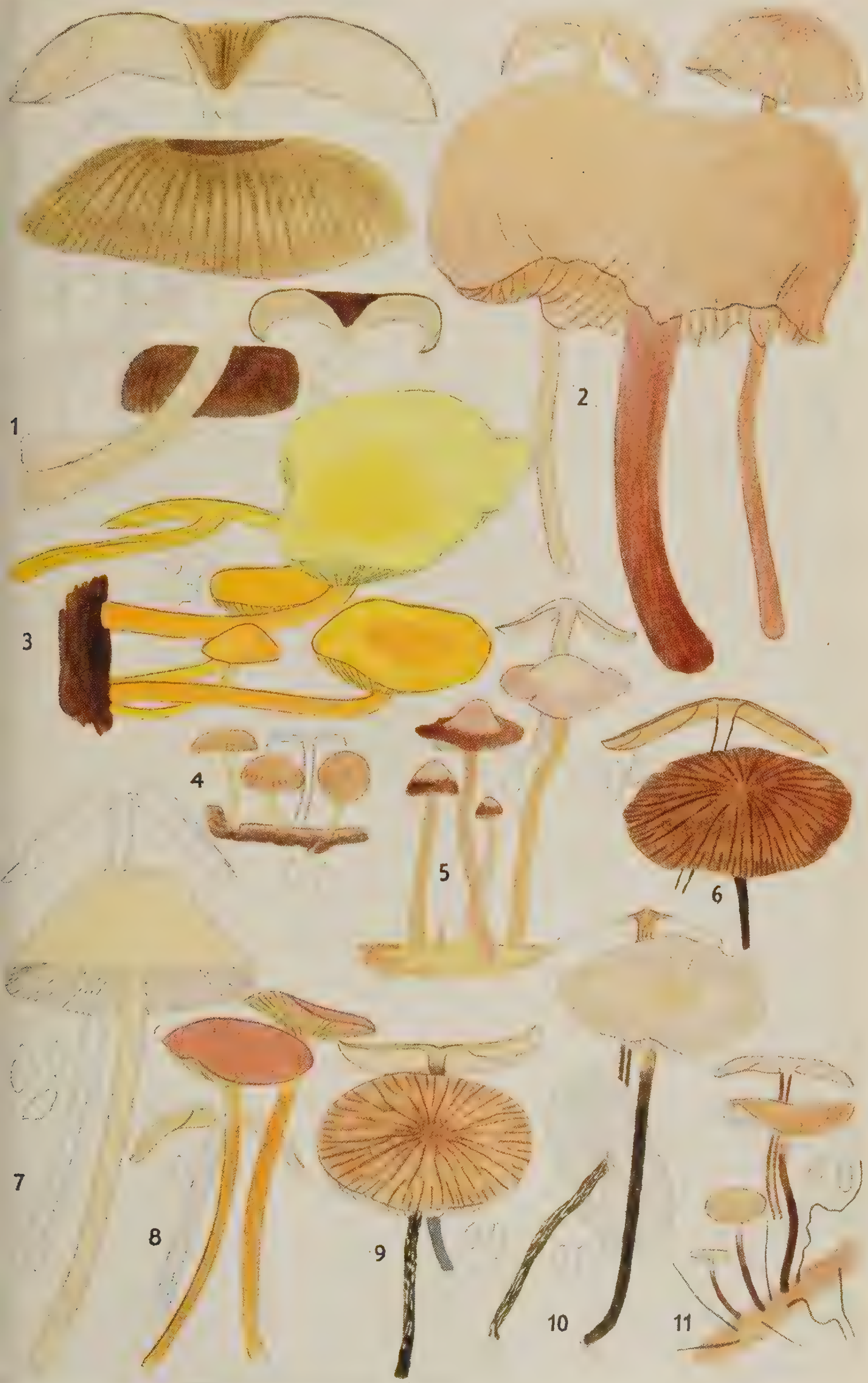
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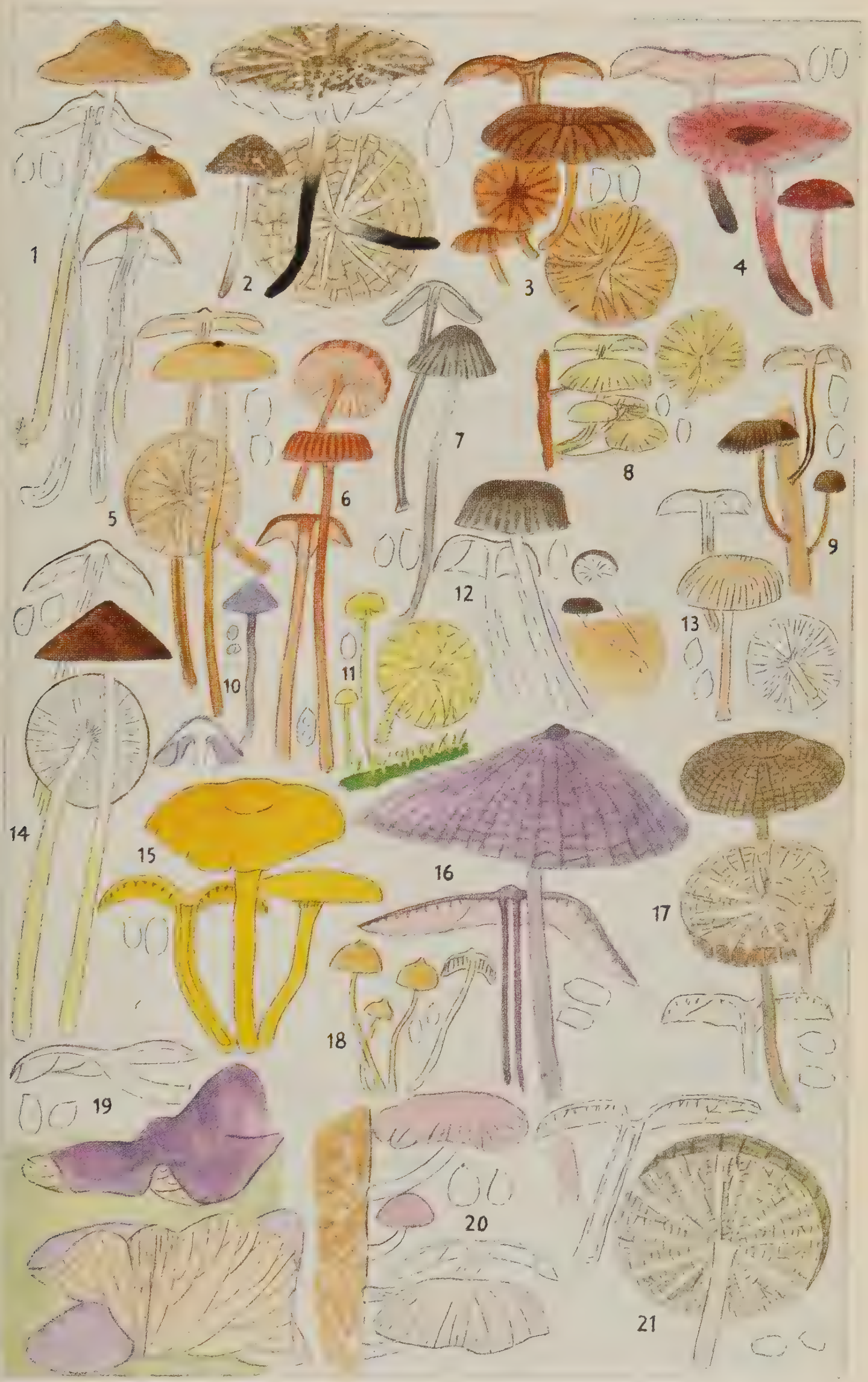
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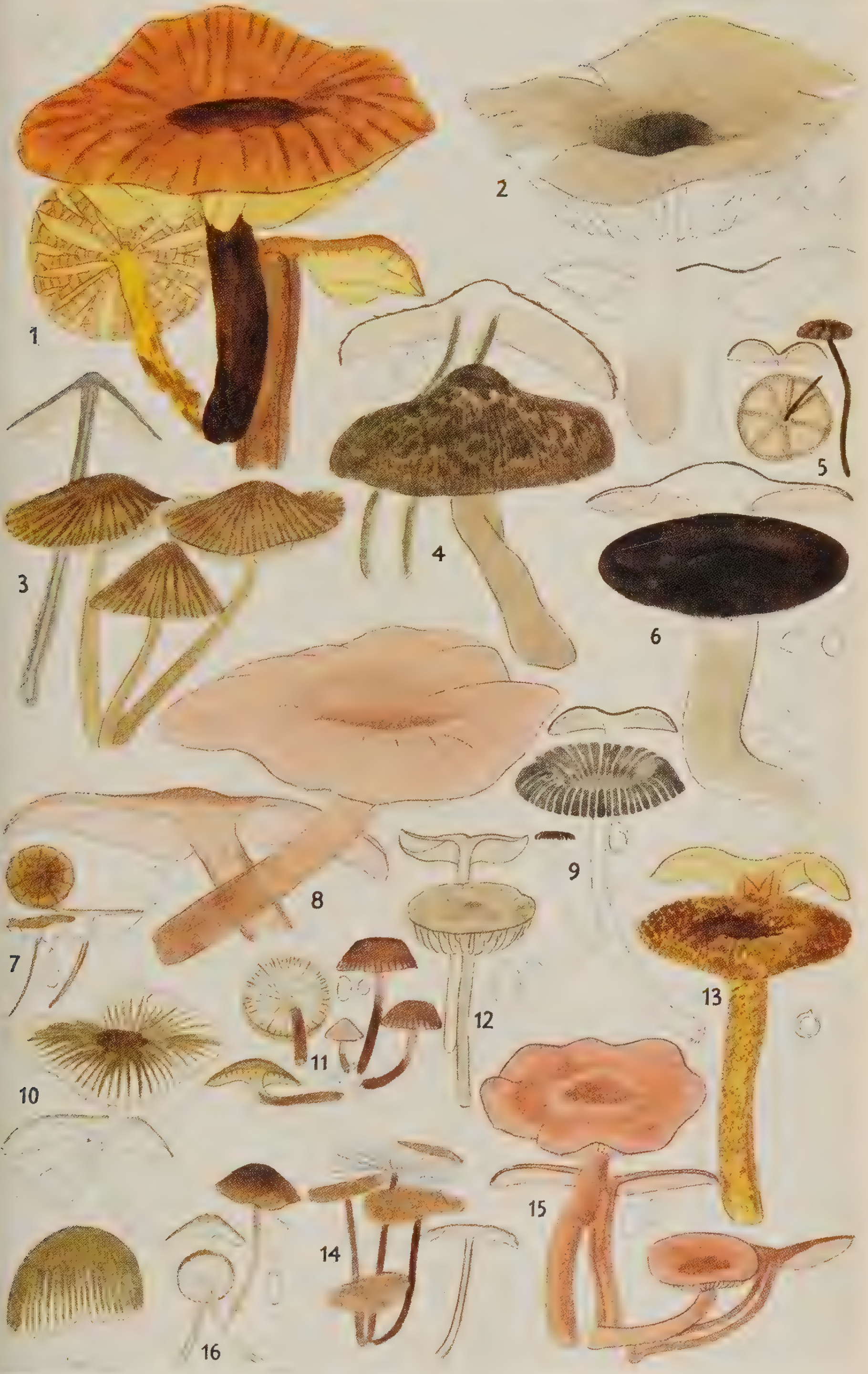
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THE LIFE-HISTORY OF *DIPLOPHLYCTIS LAEVIS*

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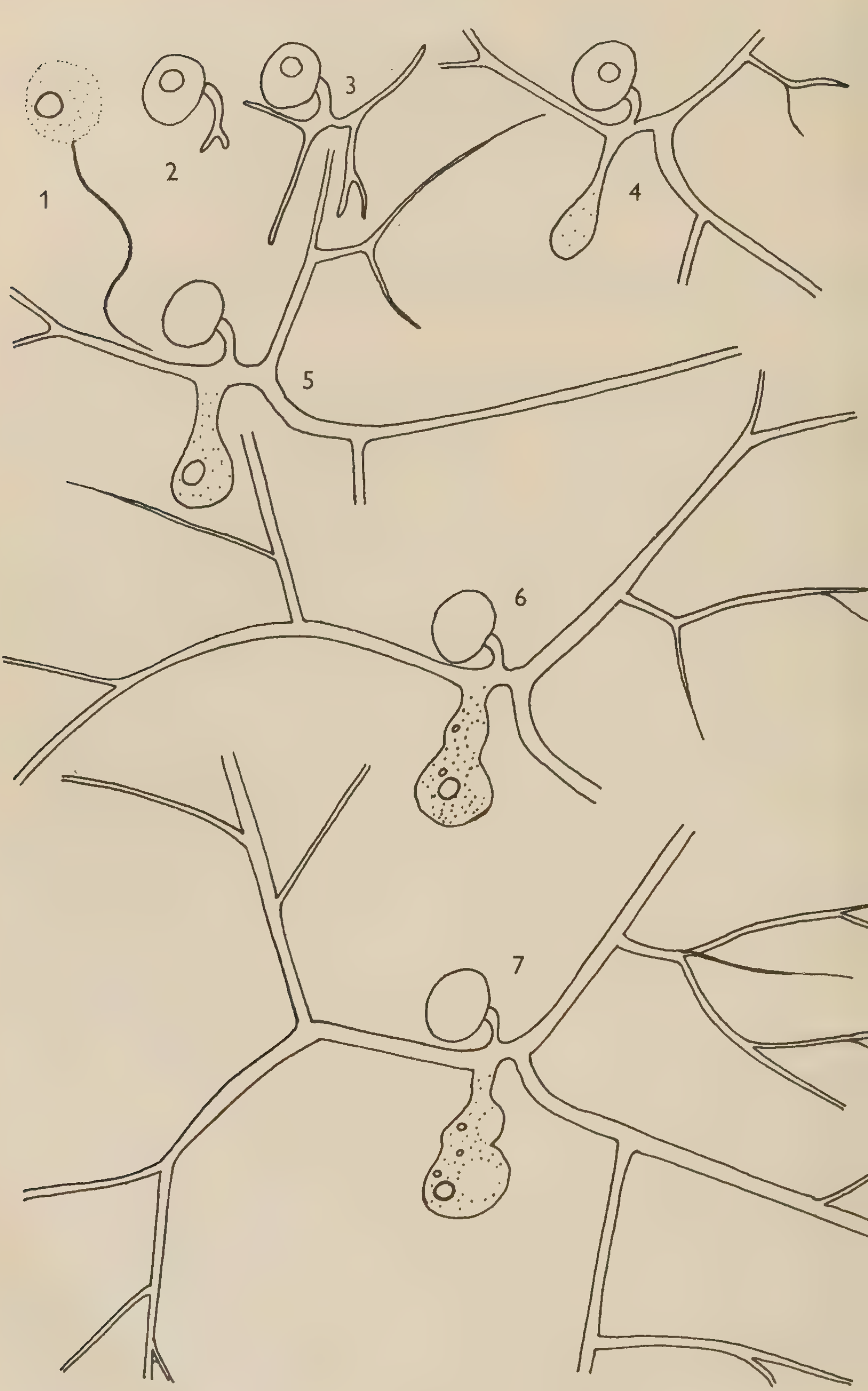
(With Plate 24, and 19 Text-figures)

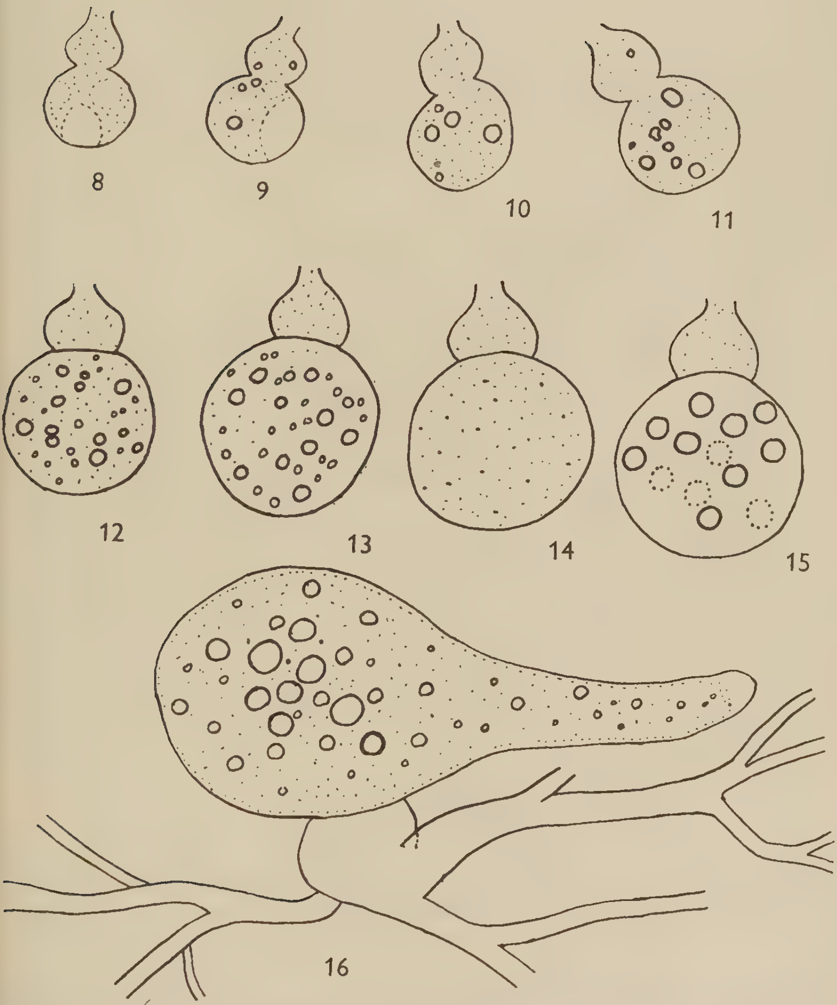
The life history of *Diplophlyctis laevis* Sparrow is briefly described, including the first account of the germination of the resting spore. This behaves as a prosporangium in its germination.

ı the course of an investigation on the aquatic chytridiaceous flora of arts of Glamorgan, *Diplophlyctis laevis* Sparrow was one of the interesting ɔecies found. The technique of the investigation followed the methods ıtlined by Couch (1939).

D. laevis was first described by Sparrow (1937, 1939), who discovered it ving in dead cells of *Cladophora* from Crooked Lake, Michigan. I have und the same species growing in moribund internodes of *Chara*, collected ı 16 February 1950, from a ditch in a railway cutting about a quarter a mile east of Bridgend; and in fragments of oat leaf which had been lded to debris brought from Pysgodlyn Mawr, St Donat's, and from enfig Pool, all in Glamorgan, South Wales.

The developmental stages of *Diplophlyctis laevis* (Text-figs. 1–16) are ore or less identical with those described by Karling (1930), for *. intestina* (Schenk) Schroeter. The zoospore settles, loses its flagellum, and oduces a germ tube which penetrates the cell wall of the host, lengthens ithin the host cell and branches, becoming a rudimentary rhizoidal stem (Text-figs. 1–3). One of the branches swells up at the tip and ceives the oil globule of the zoospore which passes down the rhizoid from e zoospore cyst, either as a whole or fragmented into several smaller ɔbules. This terminal rhizoidal swelling is the young zoosporangium ext-figs. 4, 5). Behind this terminal zoosporangium the rhizoid swells ain to produce the rudimentary subsporangial swelling or apophysis ext-fig. 6). At this stage, growth of the zoosporangium and subsporangial elling almost or entirely ceases. Meanwhile, the rhizoidal system creases greatly in extent (Pl. 24, fig. 1). After a while, the length of ıich apparently depends upon the available supply of food, growth of e zoosporangium and subsporangial swelling is continued until maturity, ıen the subsporangial swelling is separated from the zoosporangium by septum. The older zoosporangia are broadly pyriform in shape, with eir long axis parallel to the side bearing the subsporangial swelling, d the discharge tube is produced in the same plane (Text-fig. 16). This uses the subsporangial swelling to appear lateral on the zoosporangium. ıe discharge tube may be produced even before the septum has been d down. Then in the zoosporangial protoplasm, the usual changes eceding zoospore formation in the chytrids are rapidly passed through, ginning with the complete disappearance of the variously sized oil

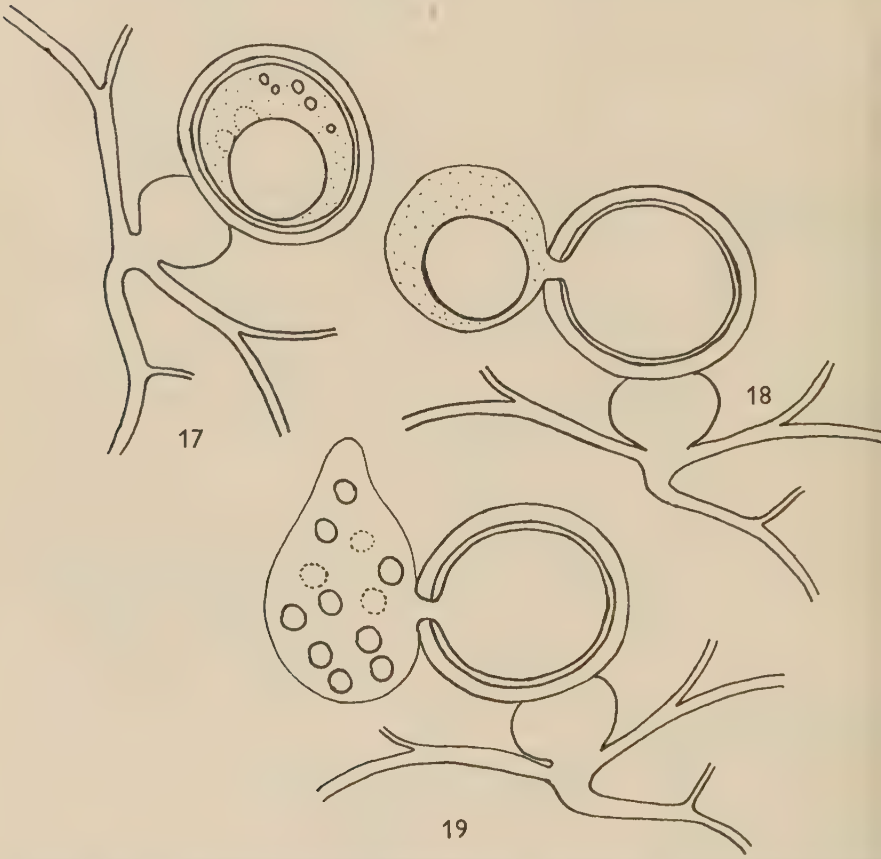




ext-figs. 1–16. Stages in the development of the thallus and zoosporangium of *Diplophlyctis laevis*. Text-fig. 1. Zoospore. Text-fig. 2. Germination of encysted zoospore. Text-fig. 3. Beginning of rhizoidal system laid down. Text-fig. 4. Rhizoidal swelling produced which is the young zoosporangium. Text-fig. 5. Globule of zoospore cyst has passed into the young zoosporangium. Text-figs. 6, 7. Subsporangial swelling is initiated and there is extensive growth of the rhizoidal system. Text-figs. 8–13. Gradual development of zoosporangium. Text-fig. 14. Disappearance of oil globules on approach to maturity of zoosporangium. Text-fig. 15. Mature zoosporangium which released its zoospores shortly after this drawing was made. The discharge tube which appeared at stage shown in Text-fig. 13 was produced in a plane vertical to the paper and so is not shown. Text-fig. 16. Another thallus showing the pear-shape of the sporangium in the plane of the discharge tube. (Magnification × 1550.)

globules and their later reappearance. Finally, the globules are of a mo or less uniform size, each globule denoting one zoospore. The outlines individual zoospores cannot usually be made out until the zoospores a released.

The zoosporangia are variable in size and shape, the greatest variatio being in the length of the discharge tube which may vary from a sma papilla of a few microns in length, to a tube which may extend up



Text-figs. 17–19. The resting spore of *Diplophlyctis laevis*. Text-fig. 17. Spore in resting conditi Text-fig. 18. Same spore germinating, producing a lateral vesicle which became a zo sporangium. Text-fig. 19. Mature zoosporangium produced from resting spore. (Magnific tion × 1550.)

$117\,\mu$ long. These discharge tubes may sometimes be found branche Occasionally, a specimen may be found with two discharge tubes opposi each other on the zoosporangium.

Resting spores are borne on the thalli in the same manner as zoosporang (Text-fig. 17). They were first observed 9 weeks after the material h been brought into the laboratory. The thalli bearing the resting spor were growing on boiled and decolorized internodes of *Chara*, which h been added as bait to the material brought from the ditch in the railw utting near Bridgend. Resting spores were not observed in the material rought from the other two sites.

The resting spores agreed closely with Sparrow's description, though e did not record a two-layered wall as seen in my material. The outer ayer of the wall is usually thicker than the inner, and the external surface s invariably completely smooth. The resting spores most frequently ontain one large oil globule, and two, three or more smaller ones Pl. 24, fig. 3), but some were observed which contained many globules f approximately the same size (Pl. 24, fig. 2), and similar to the resting pores described by Sparrow. In shape, the resting spores were usually llipsoidal, most frequently measuring about 17·5 × 16·5 μ. Only one xample was seen as large as 19·5 × 17·5 μ and two only as small as 1·4 × 10·5 μ. They were invariably borne with the subsporangial swelling t a side parallel to the long axis of the spore, and germinated by producing zoosporangium at a side parallel to the short axis (Pl. 24, fig. 4).

Germination of the resting spore has not been previously described. n this process the contents of the resting spore passed out slowly through pore in the side wall forming a spherical vesicle (Text-fig. 18 and l. 24, fig. 4), surrounded by a thin wall. This structure was a zoo-porangium, and it eventually became pyriform in shape (Text-fig. 19). he contents of the resting spore may completely evacuate the resting pore, or some of the oil globules may remain within the resting spore, nd these become irregularly shaped refractive masses. The zoosporangial vall became eventually completed over the pore in the resting-spore wall, hen the zoosporangium matured exactly as described for the ordinary oosporangium. In their escape and structure the zoospores were indis-inguishable from those produced in an ordinary zoosporangium of *iplophlyctis laevis.*

DISCUSSION

parrow (1939) suggested that the variations in shape of the zoosporangium nd the apparently lateral position of the subsporangial swelling might ave been due to restrictions of space within the *Cladophora* cells. However, ven in the relatively large space within the internodes of *Chara* the chytrid resents the same appearance. This seems to show that the features escribed are characteristic of the fungus itself and not the result of the estrictions of space imposed upon it. As Sparrow (1943) has remarked, hese features make *Diplophlyctis laevis* readily distinguishable from *. intestina* (Schenk) Schroeter, even in the absence of resting spores. have observed *D. intestina* in oat and maize leaves and stems used as bait the Water Garden, Roath Park, Cardiff. *D. intestina* has a more or less pherical zoosporangium with a basal subsporangial swelling and an pical discharge tube. The individual zoosporangia observed of *D. intestina* ere invariably larger (usually about 60 μ in diameter) than the largest bserved zoosporangium of *D. laevis.* Resting spores of *D. intestina* were ot observed. The recently described *D. sexualis* Haskins (1950) appears resemble *D. laevis* in general appearance, but is larger, has a wide thmus connecting the subsporangial swelling and zoosporangium, and is sometimes endo-operculate. The resting spore of *D. sexualis* is like tha of *D. intestina* in that the wall is spiny.

The author wishes to acknowledge his indebtedness to Prof. R. C McLean and to Dr W. R. Ivimey-Cook for their helpful advice an criticism. He also thanks Mr D. P. Guile for his assistance in collecting material containing *D. laevis*.

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EXPLANATION OF PLATE

Diplophlyctis laevis

Fig. 1: growing thallus with zoosporangium. Figs. 2 and 3: resting spores. Fig. 4: sam resting spore as fig. 3, germinating. (Magnification, × 1080; original negative, × 180.)

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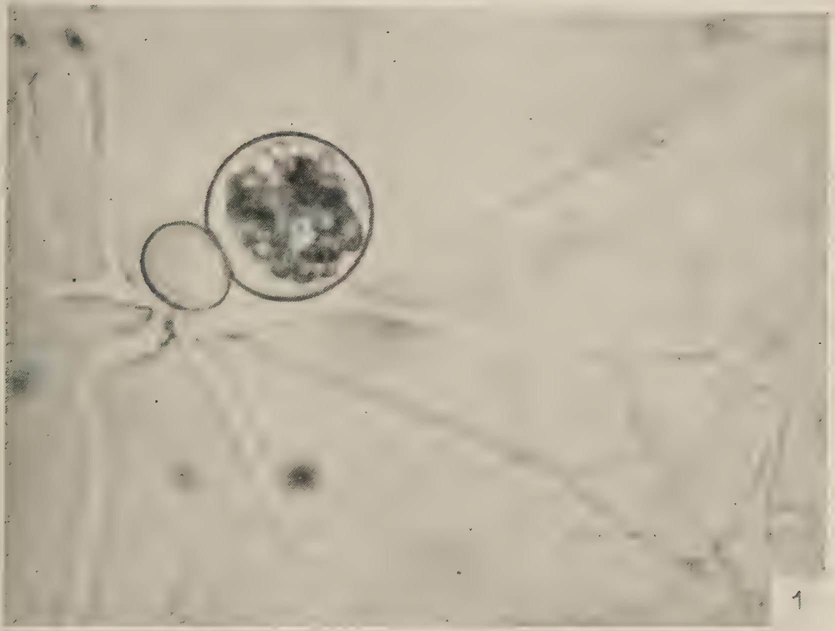

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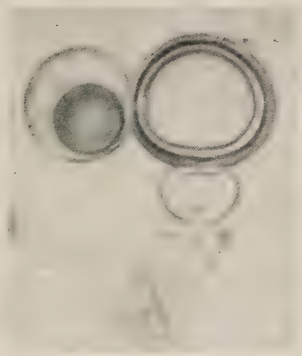

4

DACTYLELLA LOBATA, PREDACIOUS ON NEMATODES

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(With 1 Text-figure)

A species of *Dactylella* which captures nematodes by means of lobed adhesive branches is described for the first time.

Dactylella lobata sp.nov.

Mycelium sparsum, hyphis rectis, septatis, parce ramosis, 2–5 μ crassis, ramis ubglobosis lateralibus plerumque 9–13 μ longis, 8–9 μ latis; quibus ramis interdum onjungentibus ad reticula formanda; vermiculos nematodeos ad ramos inhaerentes apiens; tuber infectionis per integumentum vermiculi e quo hyphae edentes excrescunt ntrudentibus. Conidia hyalina, fusiformia, 32–54 μ longa, 8–12 μ crassa, septo transverso n 3–5 cellulas divisa, ad apices hypharum fertilium erectorum circa 250 μ altos orrigentia.

Vermiculos nematodeos diversos capiens consumensque usque plus quam 500 μ ongos, hab. in v. circa *Dicranella heteromalla* Schp., Wimbledon Common, London, May 950.

This fungus was first observed in plates of maize-meal agar inoculated vith small quantities of the moss *Dicranella heteromalla* Schp. collected from eside a path on Wimbledon Common, near Wimbledon Golf Club. The nycelium of septate hyphae ran straight across the surface of the medium, ranching occasionally and bearing at fairly regular intervals curious ubspherical outgrowths (Fig. 1 *a*). The hyphae were 2–5 μ wide, and the utgrowths measured 9–13 × 8–9 μ. On older hyphae the outgrowths roliferated (Fig. 1 *b*), forming lobed branches which were often forked, nd which sometimes joined together to form loops.

Nematodes were captured by sticking to the lobes. An outgrowth enetrated the integument of the animal, and formed an infection bulb vithin its body from which grew trophic hyphae (Fig. 1 *e*). These hyphae vere usually 4–6 μ wide, and contained numerous oil globules. The body ontents of the captured nematode were quickly absorbed. Anastomoses etween trophic hyphae were more common than usual, and another istinctive feature was the production of large quantities of oily material n the carcass of the eelworm.

Conidia were formed abundantly after a period of feeding. They were arried singly, each at the apex of an erect conidiophore, usually about 50 μ high. The conidia were fusiform, usually four-celled, with a wall bout 1 μ thick, and were mostly 32–54 μ long and 8–12 μ wide (Fig. 1 *d*). Germination was usually, though not always, from one of the end cells, nd often resulted in the direct formation of an adhesive lobe (Fig. 1 *c*).

The fungus was isolated and grew well, though rather slowly, on maize-neal agar and on potato dextrose agar. No lobes were formed in pure

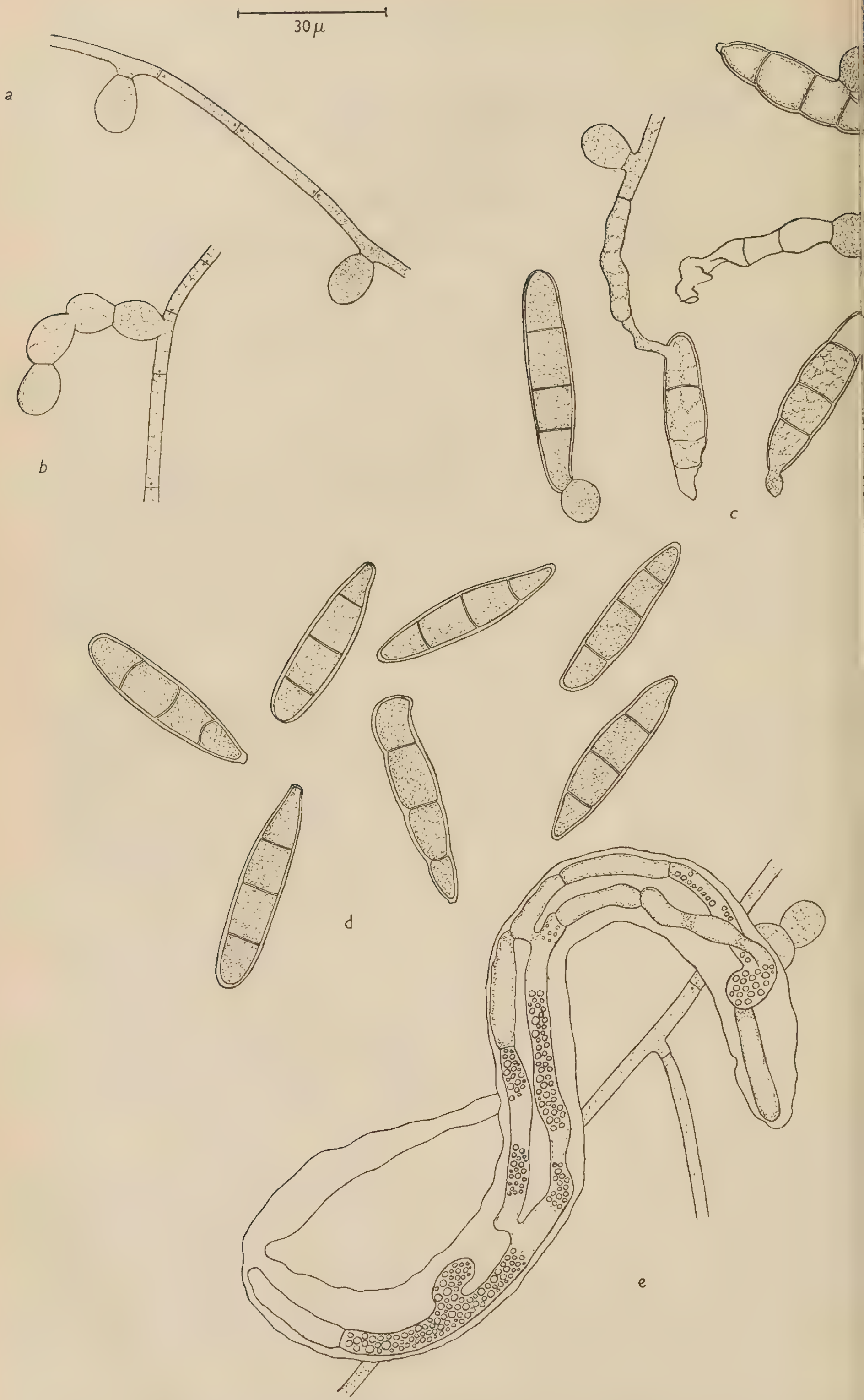

Fig. 1. *Dactylella lobata* n.sp.: *a*, mycelium with lobes; *b*, proliferating lobes; *c*, germinating conidia; *d*, conidia; *e*, captured nematode showing trophic hyphae.

lture, but conidia were produced very abundantly, and were rather
ore slender than those from cultures containing nematodes, measuring
–54 × 8–10 μ.

The lobed outgrowths formed by this fungus slightly resemble those of
actylella cionopaga Drechsler (1950), but the adhesive processes formed by
at species are more pointed, and they do not show proliferation;
oreover, the conidia of the two fungi are quite different. As far as
know, lobes of this sort are unique in a predacious hyphomycete, so it
ems necessary to erect a new species. The hyaline, multiseptate conidia
rne singly on erect fertile hyphae indicate *Dactylella* Grove, and it is
cordingly proposed as a new species of that genus, the epithet *lobata*
ferring to the peculiar form of the predacious apparatus.

All measurements and diagrams used in describing this fungus have
en prepared from living material mounted in water. Type specimens
ll be deposited in the Herbarium of the Royal Botanic Gardens, Kew,
d in the Herbarium of the Commonwealth Mycological Institute, Kew.

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FUSARIUM OXYSPORUM SCHL. F. AS THE CAUSE O VASCULAR WILT DISEASE OF THE OIL PALM (*ELAEIS GUINEENSIS*)

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In inoculation experiments, which are described in detail, *Fusarium oxysporum* Schl. f. isolated from the necrosed vessels of a typically wilted oil palm, has caused root disease and vascular infection (tracheomycosis) of young seedlings, the pathogen being duly re-isolated. The pathogenicity of this fungus to *Elaeis guineensis* J. has thus been established.

Wardlaw (1946*a–c*, 1948*a*, *b*, 1950) reported the widespread occurrence a vascular wilt disease of the oil palm (*Elaeis guineensis* J.) in the Belgia Congo and Nigeria. Strains of the pathogen, identified as *Fusariu oxysporum* Schl. f., have been studied by Gogoi (1949, 1950), whil Kovachich (1948) has described and illustrated the morbid anatomy the diseased host. Experimental evidence of the pathogenicity of th organism to the oil palm, however, had still to be obtained: hence th investigations described in the present paper. The problem was to fin a method of inoculation by which proof of the pathogenicity of *F. oxysporu* Schl. f. to the oil palm could be obtained. Inoculation experiments carrie out at the Laboratoire Central de Phytopathologie de l'INEAC, Yangamb Belgian Congo, constitute an essential preliminary step in the experiment investigation of this important disease.

All the tests were made on vigorous seedlings of *Elaeis guineensis* J. havi two leaves. Cultures of *Fusarium oxysporum* were isolated from a typic specimen of vascular wilt disease at Yangambi.

Preliminary experiments

In some preliminary investigations seedlings were transferred to tubes an grown in a nutritive solution. After 1 week, they were inoculated dipping the root system in a diluted liquid culture of the *Fusarium*. Th mineral solution of the tubes was frequently renewed. After 2 mont some differences between the inoculated and the non-inoculated seedlin could be observed. Attempted isolations from the inoculated seedlin gave only 20 % positive results, the pathogen being obtained from brow roots, but rarely from the 'bulb', i.e. the shoot, of diseased plants. It w thought that, with suitable improvements, this system of inoculati afforded a basis for further infection experiments.

In a further exploratory test, several seedlings were transplanted metal pots containing a mixture of 50 % sand and 50 % forest so Inoculation was effected by adding cultures of the fungus on a rice pad edium at the time of replanting. After 3 weeks, when isolations were tempted, *F. oxysporum* was obtained in a few instances only. However, was ascertained that the seedlings were often infected in the roots and ulb' by *Thielaviopsis paradoxa* (d. Seyn.) v. Höhn.—a facultative parasite *Elaeis* seedlings in nurseries. Both the desirability and need for soil erilization were indicated by these observations.

Soil was accordingly sterilized with chloropicrin, and a large amount of oculum was incorporated when the seedlings were transplanted. In this periment, the attack on the root system was rapid and intense, every root ing killed within such a short time that the normal development of the sease could not be observed. It was concluded that this method would ve satisfactory results provided a smaller quantity of inoculum was plied to the base of the root system instead of all around it.

PROCEDURE IN MAIN INFECTION EXPERIMENTS

combining the experience of the earlier experiments with the methods Wellman (1939) an experimental technique was devised which included: (1) use of young seedlings of *Elaeis*; (2) use of poor, light sandy il, sterilized; (3) inoculation of seedlings by dipping the root system in diluted liquid culture; (4) planting of inoculated seedlings in small pots ntaining sterilized soil; (5) maintenance of the inoculated plants under vironmental conditions assumed to be favourable to the growth both of e plant and the fungus. It was necessary to use an effective sterilizing stem which left no residual toxicity for the seedlings and the inoculum.

Sterilization with chloropicrin. The dry soil was distributed in metallic ntainers of 100 l. capacity. The chloropicrin was poured into holes out 15 cm. deep and 15 cm. apart in order to obtain a uniform distribuon of the gas through the soil. One ml. of pure chloropicrin was used r 8 l. of soil. Before and after applying the chemical, the soil was rinkled with water.

One week after the treatment, small zinc containers, sterilized by dipping a formalin solution, were filled with the treated soil. By this time, the lour of chloropicrin had completely disappeared. The containers were linders, 20 cm. in diameter by 18 cm. in depth, holding 5 l. of dry soil. here was a hole in the bottom of each container 5 cm. in diameter, over hich a flat piece of zinc was placed. This allowed the surplus water to ain out. The smaller cylinders were placed in another, 24 cm. in ameter and 15 cm. in depth, with a leak-proof bottom.

Sterilization with formalin. The operation with formalin was carried out the same way as for chloropicrin. The treatment of the soil consisted in plying a 4 % solution of formalin in water. Twenty-five litres of formalin lution were used per 1 cu.m. of soil. The soil was left for a week and en put in the small cylinders. At the time of filling the small containers, e odour of formalin had not disappeared and the chemical was neutralized adding ammonium sulphate.

Steam sterilization. The small cylinders were filled with untreated soil d were placed in an autoclave at 120° C. for 30 min. the day before ey were to be used.

Seedlings and inoculation. The seedlings of *Elaeis guineensis* J. used in th experiment came from second-grade seeds from a Tenera × Dura cros The seeds were placed in a germination box on 3 December 1949. Aft sprouting or germination, the seedlings were transplanted in seed bed Healthy, vigorous and equally developed seedlings were selected, eac with two leaves.

Seven days after sterilization with formalin or chloropicrin and 1 da after steam sterilization, the seedlings were lifted and their root systen washed in water. They were then dipped in a diluted liquid culture of th fungus. The plants were then transplanted in the small cylinders (fou seedlings in each). The control plants received the same treatment excep that dipping in the culture solution was omitted. These operations too place on 17 May 1950.

A culture of *Fusarium oxysporum* Schl. f., was isolated from a wilted oi palm (tree no 2529, field B, Yangambi). The organism was first cultivate on potato-dextrose agar (Difco) and identified on this medium. Later, was transferred to Richard's solution for 1 week. At the time of th inoculation, these cultures were diluted ten times.

The experiment consisted of eighteen cylinders, i.e. six for each syste of soil sterilization. In each series, two pots contained the non-inoculate control seedlings, the four others being inoculated. They were placed und an aluminium-sheet roofing which gave protection from the rains an received direct sunshine only during a few hours of the day. During th experiment, the seedlings were watered every other day.

RESULTS

Soil disinfected with formalin. Eight days after inoculation, every seedlin was dead. Efforts to isolate the *Fusarium* from the seedlings were negativ This general and quick mortality was undoubtedly the result of th chemical toxicity of the soil.

Soil disinfected with chloropicrin. About 40 days after inoculation, som differences appeared between the inoculated seedlings and the contro The latter were healthy and dark green. Their development appeared be better than in the inoculated seedlings. The latter showed som symptoms, including a yellowing of leaves which later turned brown an dried up. Some of the basal leaves were completely brown and dr Usually these symptoms, which appeared first on the basal leaves an then on the younger ones, increased with time until the plant showe evidence of a general physiological deficiency of some intensity.

After 2 months (14 July 1950), many of the inoculated seedlings we severely injured and some of them were dead. The experiment w concluded and the root systems inspected.

The control plants were of normal appearance and showed only norm brown and creamy white roots. The inoculated seedlings had as ma roots as the controls but some had become black and were hollow. Othe were normal in appearance. Some roots were found to contain a centr brownish cylinder surrounded by a normal cortical layer. Dissection the inoculated seedlings revealed an internal necrosis in the 'bulb' ioot. The internal tissues were light brown, or darker, and at their limit could be seen that this darkening was restricted to the vessels. Along longitudinal section, these brown vessels could be followed over a length f 1 cm. among the healthy tissue. These internal symptoms were never een in the 'bulb' of the non-inoculated seedlings.

Marked differences in the leaves, the roots and in the 'bulb' of the ioculated and the non-inoculated seedlings were observed.

Re-isolation of the fungus. Three systems of isolation were tried:

Pieces taken from the base of the roots were disinfected on the surface ith silver nitrate (solution 0·4 %), dipped in sterile water, then transferred o potato-dextrose agar (Difco).

Pieces taken from the base of the roots were disinfected on the surface ith strong alcohol, passed through the flame of an alcohol lamp, then ransferred to the same type of sterile medium.

Pieces of internal tissues of the 'bulb' were removed aseptically and ransferred to the type of medium.

The last procedure gave positive results and showed definitely that the rganism had infected that region; it gave pure cultures only. From the oots, the pathogen was rarely obtained alone.

Isolations from the non-inoculated seedlings have never given a *Fusarium*. he isolations obtained from every inoculated seedling gave pure and ery homogeneous cultures of a fungus, particularly when they were nade from the internal tissues of the 'bulb'. This fungus proved to be the ne used for inoculation: *F. oxysporum* Schl. f.

These results show that the procedure adopted was quite satisfactory, ll the inoculated plants being infected. The cultural conditions were vidently favourable to the penetration of the root system of seedlings by ne pathogen and to its spread within the shoot. The environmental onditions were not controlled. It may be recorded, however, that the emperature of the soil was never more than 29° C., with a minimum of 0° C. The soil was relatively dry and the time of exposure to direct unlight limited.

When this experiment was repeated on a larger scale, similar results ere obtained.

Soil treated by steaming. Generally speaking, observations comparable ith those above were made, but there was less homogeneity in the symp-oms in the inoculated seedlings. The results on re-isolation of the fungus ere as follows: from the control seedlings *Fusarium* was never obtained; hile *F. oxysporum* Schl. f. was found in 82 % of the inoculated seedlings.

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BRITISH MARSH AND FEN FUNGI. II.

By M. B. ELLIS, *Commonwealth Mycological Institute, Kew*
E. A. ELLIS, *Castle Museum, Norwich*
and J. PAMELA ELLIS

(With 10 Text-figures)

A further six fungi found on marshes and fens in Great Britain are described and figured, viz.: *Arthrinium curvatum*, *A. curvatum* var. *minus* n. var., *A. puccinioides*, *A. sporophleum*, *Papularia arundinis* and *P. sphaerosperma*. Notes are made on spore dispersal, spore germination, times of occurrence, substratum range and cultural characters. A key to the British species of *Arthrinium* is given.

Arthrinium

The genus *Arthrinium*, although not confined to marshes and fens, is very well represented in these habitats. The dark brown or black colonies are round, oval or irregular in shape. Each colony consists of a mass of closely packed conidiophores borne on a superficial mat of mycelium which is one or more cells deep; the conidiophores are mostly upright but may splay out and become parallel with the leaf surface at the periphery of the colony. There is an internal and an external mycelial system. The supericial mycelial mat consists of closely interwoven and anastomosing hyphae radiating from a central area where they connect up with the internal mycelium both through the stomata and directly through the cuticle (Fig. 19 I). The individual cells which make up the mycelial mat are of different shapes and sizes and, in surface view, resemble the pieces of a jig-saw puzzle (Fig. 21 K). In young colonies the superficial mycelium s hyaline; with age the cells turn brown, a few at a time, until finally, in old colonies, the whole network is composed of brown cells. The internal mycelium ramifies extensively through the epidermis and mesophyll below, but does not appear to extend far beyond the periphery of the individual colonies. Each conidiophore consists of a single filament divided into a number of hyaline cells by transverse, dark brown septa; the cell at the base of the conidiophore is swollen and there is a swelling in the region of each septum. The characteristic dark septa, although usually confined to he conidiophores, are also sometimes seen between the cells of the supericial mat. The conidia are pale to dark brown in colour and vary in shape, he shape being more or less constant for each species. Conidia are normally borne on short, hyaline pegs arising from the central region of each cell. In preparations in lactic acid one seldom finds more than one or two conidia attached to each cell; the presence of additional pegs shows, however, that three or even more may be formed there. Old and young conidia may occur together at any level, and there seems to be no fixed order of development, although the majority of very young conidia are nearest to the base. At the apex of the conidiophore, and occasionally also along its sides in place of conidia, there are borne special cells which, when fully formed, are much paler than the mature conidia and are often irregular in outline; they frequently contain one or two highly refractive cubical bodies and possibly serve as storage organs for waste metabolic products (Fig. 21 E–G). Large numbers of these cells are produced by *A. sporophleum* when it is grown on artificial media. In all species of *Arthrinium* on natural substrata the cells are most abundant towards the end of the growing season. These cells are variable in form; in some species, e.g. *A. curvatum* and *A. cuspidatum*, they often have the same shape as conidia but in others, e.g. *A. caricicola* and *A. sporophleum*, they are quite different. The development of the conidiophore is characteristic. There is a swollen, phialide-like basal cell from the apex of which the stipe develops. A short tube is put out at first (Fig. 19 F); this swells at its tip and the swollen and sometimes characteristically lobed end portion is cut off by a septum to form the terminal cell which soon turns brown (Fig. 22 I). Further growth takes place from the base and the first formed portion of the stipe is pushed forward. Thick septa are laid down; these are hyaline at first but soon turn dark brown. Deep staining with cotton blue shows that there is protoplasmic continuity between the individual cells of the stipe, and that fine threads of protoplasm pass out laterally from a central column into the pegs bearing young conidia (Fig. 22 H).

Conidia of *A. puccinioides* and *A. sporophleum* were collected on spore traps set on poles 6 ft. above the ground at Wheatfen Broad, Norfolk, during April, May and June 1949. They were found also in surface films on the dikes and in the slime tracks of the mollusca *Agriolimax agrestis*, *Arianta arbustorum*, *Limnaea palustris*, *Succinea putris* and *Vertigo moulinsiana*. Slugs and snails regularly travel up and down marsh and fen plants and carry numerous fungus spores with them. Insects serve as carriers also: spores of *Arthrinium sporophleum* were isolated from a leaf-hopper *Philaenus leucophthalmus* and those of *Arthrinium puccinioides* from a beetle *Paederus riparius*.

Höhnel (1925) summarized the work done on *Arthrinium* and pointed out that, apart from spore shape, there were no essential differences between the genera *Arthrinium*, *Camptoum* and *Goniosporium*. *Arthrinium curvatum* was grown on autoclaved stems of various plants by Mme Gutner (1927); she referred to unsuccessful attempts by A. Potebnia to grow the same fungus in pure culture on agar. In the present study the cultural characters of *A. puccinioides*, *A. sporophleum* and *A. curvatum* var. *minus* are given. *A. puccinioides* grows slowly and forms conidia on potato-dextrose agar; *A. sporophleum* can be grown on several media and sporulates freely on maize meal agar; *A. curvatum* var. *minus* did not form conidia on potato-dextrose agar, maize meal agar, *Carex* agar, or on culms of *Scirpus tabernaemontani* sterilized with propylene oxide; on the first two media, however, perithecia often developed. Three species of *Arthrinium* and one variety have been found on marsh and fen plants in Great Britain. No British collections of *A. caricicola* Kunze ex Fr. (Fig. 15) or *A. cuspidatum* (Cooke & Harkness) Höhnel (Fig. 16) have been seen, although Massee cites the former in his *British Fungus Flora*, **3**, 373 (1893), and in Berkeley's Herbarium in Herb. Bot. Reg., Kew, there is a specimen of this fungus labelled *A. caricinum* but no locality is given. Numerous European collections of

. *caricicola* on *Carex ciliata*, *C. digitata*, *C. ericetorum* and *C. praecox*, and of . *cuspidatum* on *Juncus filiformis* and *J. jacquini* have been examined gether with American collections of the latter fungus on species of *uncus* and *Scirpus*.

The different British species are readily distinguished from one another y their conidia. The conidia are always somewhat flattened in one plane, d in the following key the shape and size of the larger surface is given.

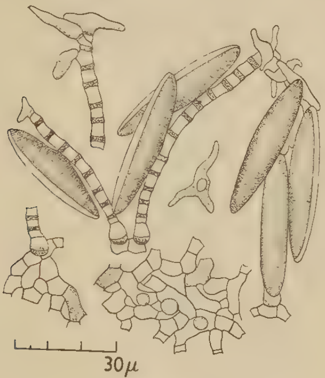


Fig. 15. *Arthrinium caricicola.*

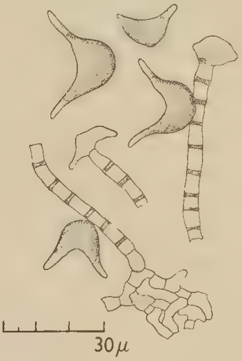


Fig. 16. *Arthrinium cuspidatum.*

Key to the British species of Arthrinium

Conidia curved: (*a*) 11–14μ by 6–8μ	*A. curvatum*
(*b*) 8–10μ by 5–6μ	*A. curvatum* var. *minus*
Conidia polygonal, mostly 12μ in diameter	*A. puccinioides*
Conidia lemon-shaped, mostly 12μ by 6μ	*A. sporophleum*

(11) **Arthrinium curvatum** Kunze ex Fries, *Systema Mycologicum*, **3**, 377 (1832).

Camptoum curvatum Link in *Linn. Spec. Plant.* Ed. 4, 6, Pt. 1, 44 (1824).

A. curvatum is usually found on dead leaves of *Scirpus sylvaticus* but has en recorded a few times on *S. lacustris* and on *Carex acutiformis* and *riparia*. The colonies are small, compact, dark brown, oval to round, ten confluent, 140–500 by 160–600μ; they are found on both the upper d lower leaf surfaces. The embedded mycelium (Fig. 17 D, E) is comsed of hyaline to very pale brown, smooth, branched, septate hyphae, 4μ in diameter, with cells 4–26μ long. The superficial mycelium ig. 17 C) is made up of hyaline to brown, smooth, branched and astomosing hyphae, 3–7μ in diameter, with cells 4–17μ long. The nidiophores (Fig. 17 B) are narrow, cylindrical, unbranched, straight flexuous, hyaline, with dark brown septa, smooth, with a phialide-like sal cell and a pale brown terminal cell which is flattened and either und, oval or curved in side view; they are 46–86 (60)μ long, 6–14-tate, 2–3·5 (2·6)μ in diameter between the septa and 4·5–6 (5·2)μ at e base. The conidia (Fig. 17 A) are sessile or, more usually, borne on ort hyaline pegs along the sides of the conidiophores between the septa ig. 17 B). They are somewhat flattened in one plane, curved in side view, with a well-marked scar often clearly visible on the convex side, brow often pale at the tips, smooth, often shining, 11–14 (12·6) by 6–8 (7). Conidia from thirty-one collections were examined; little difference w found between collections made on the different substrata at differe times of the year.

The life history of *Arthrinium curvatum* was worked out by Mme Gutn (1927). From a study of herbarium material she concluded that the fung was restricted, in nature, to dead leaves of *Scirpus sylvaticus*. There is n doubt that this is the usual substratum but, as is the case with man

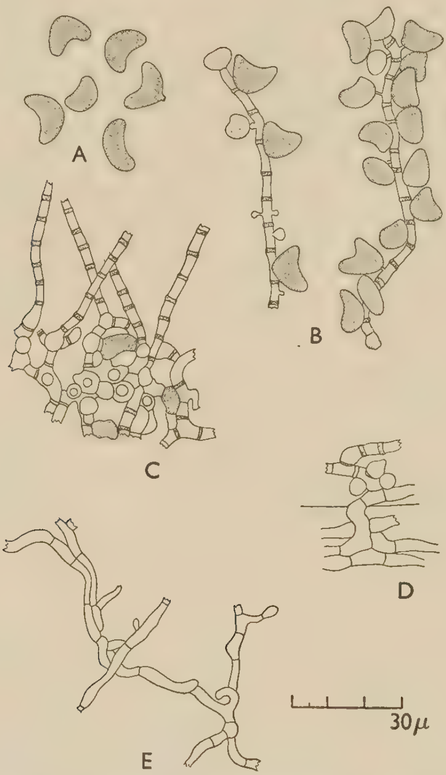


Fig. 17. *Arthrinium curvatum*. A, conidia; B, conidiophores; C, part of the superficial myceli mat; D, hyphae passing through to the surface; E, embedded mycelium.

hyphomycetes, the fungus occasionally occurs on other substrata. Mm Gutner cultured *Arthrinium curvatum* on autoclaved stems of various plant including *Scirpus sylvaticus*, *Typha latifolia*, *Sparganium ramosum*, *Potamoget natans*, *Alisma plantago*, *Phragmites communis*, *Triticum vulgare*, *Avena sativ Phalaris arundinacea*, *Juncus conglomeratus*, *Iris pseudacorus* and *Veroni beccabunga*, and obtained both a conidial and a perithecial state; to tl latter, seen only in culture, she gave the name *Pseudoguignardia scirp* Sporulation occurred only when there was a plentiful supply of moistur On some substrata both conidia and perithecia were formed, on othe only one state or the other was found. In this connexion it is interestin o note that on artificial media on which they have so far been grown *Arthrinium puccinioides* and *A. sporophleum* have formed conidia only, whilst *A. curvatum* var. *minus* has formed perithecia but no conidia.

(12) **Arthrinium curvatum** Kunze ex Fr. var. **minus** M. B. Ellis, var.nov.

Caespitulus velutinus, atro-brunneus, rotundus, 70–380 μ diam. Conidiophora recta vel flexuosa, hyalina, 36–74 (56) μ longa, brunneo-annulato-septata, ad septa 2–4 (3) μ ata, basim versus 4–5 (4·8) μ lata. Conidia curvata, brunnea, 8–10 (9) μ longa et 5–6 μ lata.

Hab. In culmis emortuis Scirpi tabernaemontani, Wheatfen Broad, Surlingham, Norfolk, England, 27 December 1947, E. A. & M. B. Ellis, Herb. I.M.I. No. 21201*a* (Type).

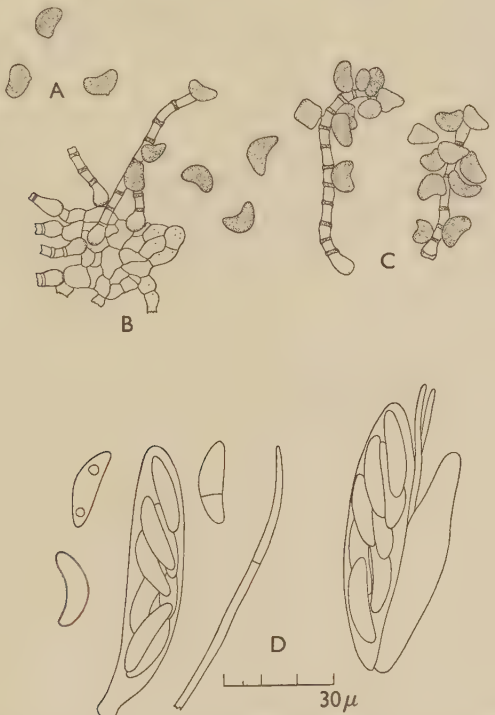


Fig. 18. *Arthrinium curvatum* var. *minus*. A, conidia; B, part of the superficial mycelial mat with attached conidiophores; C, conidiophores; D, asci, paraphyses and ascospores from perithecia produced in culture on maize meal agar.

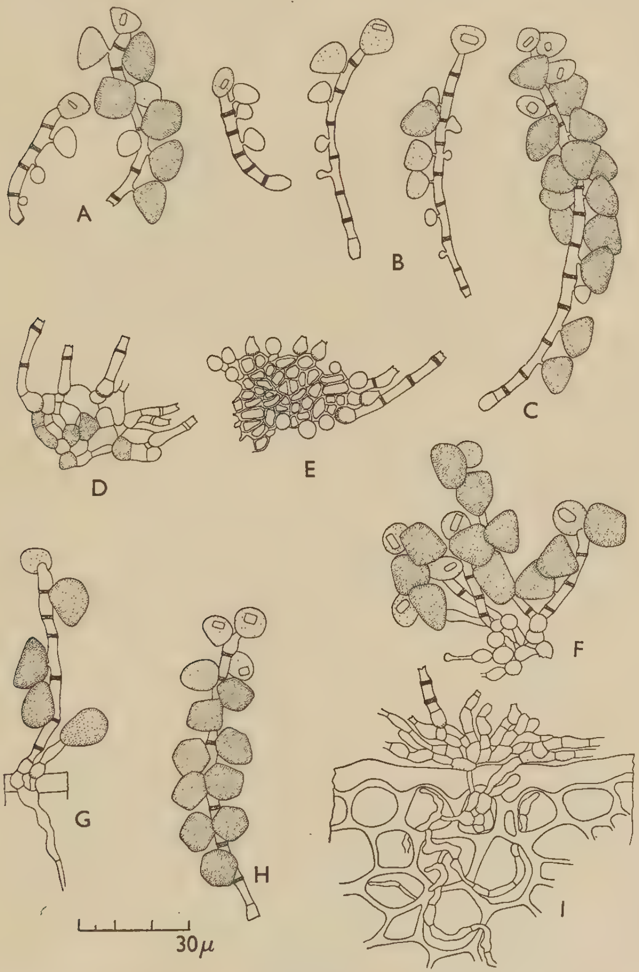
This variety of *A. curvatum* has been found in Great Britain on dead leaves and culms of *Carex hirta*, *C. riparia*, *Juncus conglomeratus* and *Scirpus tabernaemontani*. It is characterized by its small, curved conidia. The colonies are small, compact, very dark brown to black, round, 70–380 μ in diameter. The superficial mycelium (Fig. 18 B) is composed of hyaline to pale brown, smooth hyphae 2–7 μ in diameter, with cells 4–10 μ long. The conidiophores (Fig. 18 C) are narrow, cylindrical, unbranched, straight or flexuous, hyaline with thick, brown septa, smooth, with a hyaline, phialide-like basal cell and a pale brown terminal cell which is flattened and appears either round, oval or curved in side view; they are 36–74 (56) μ long, 2–4 (3) μ in diameter at the septa and 4–5 (4·8) μ at the base, and 7–14-septate. The conidia (Fig. 18 A) are sessile or, more usually, borne on short, hyaline pegs along the sides of the conidiophores between the septa; they are flattened, appearing curved in side view with a well-marked scar clearly visible on the convex side, brown, smooth, 8–10 (9) μ long and 5–6 (5·5) μ wide.

In tap water the percentage of germinating conidia was found to be low; after 24 hr. only a few conidia put out very short germ tubes. Conidia germinated readily, however, on potato-dextrose agar. Plates of potato-dextrose agar were inoculated with the fungus on 7 January 1948 and kept at laboratory temperature. By 16 February colonies 75 mm. in diameter had developed; the mycelium was partly embedded in the substratum and partly superficial, the superficial mat forming a thin, white weft closely pressed to the surface of the agar. In reverse the colonies were a pale peach colour. No conidia were formed but numerous perithecia appeared, embedded in loose, brown stromata 1–2 mm. in diameter. On 25 January transfers were made to maize meal agar. Colonies extended to 75 mm. by 25 February. The superficial mycelial mat was thicker than the one produced on potato-dextrose agar and was pale pink; numerous perithecia were formed in loose brown stromata. Above the stromata the mycelial mat was humped, and drops of orange-coloured fluid were exuded. Cultures were kept for 6 months on slopes of potato-dextrose agar, maize meal agar and oatmeal agar; on none of these media were conidia formed. Newly dead culms of *S. tabernaemontani*, which had been sterilized with propylene oxide and partly embedded in tap-water agar, were inoculated with the fungus on 12 February 1948; by 30 March although there was a copious growth of white to pale yellow mycelium no conidia or perithecia were formed. Isolations were made also from *Carex hirta* and *Juncus conglomeratus*; plates of *Carex* agar and potato-dextrose agar were inoculated on 24 April 1948 and kept at room temperature until 2 June 1948. On *Carex* agar only a thin, web-like superficial mat was formed. On potato-dextrose agar white to very pale pink colonies, peach coloured in reverse, 90 mm. in diameter were formed; here, again, numerous perithecia but no conidia developed. The perithecial state closely resembles that of *Arthrinium curvatum*, described by Mme Gutner (1927) and named by her *Pseudoguignardia scirpi*. The asci and spores (Fig. 18 D) are rather smaller, measurements in μ being 62–75 by 15–16 and 18–24 by 6–8, compared with 93·6–100 by 16·5–19·2 and 19–30 by 7·6, and the spores are often distinctly curved. There is no doubt that the fungus described above is very closely related to *Arthrinium curvatum* and it is considered to be a small-spored variety of that species.

(13) **Arthrinium puccinioides** (DC.) Kunze ex Fries, *Systema Mycologicum*, **3**, 376 (1832).

Conoplea puccinioides De Candolle in Lamarck & De Candolle, *Flore française*, Ed. 3, **2**, 73 (1805).
Goniosporium puccinioides Link in *Linn. Spec. Plant.* Ed. 4, 6, Part 1, 45 (1824).
Gonatosporium puccinioides Corda in *Anleitung zum Studium der Mycologie*, 61 (1842).

A. puccinioides appears to be the commonest and most widely distributed pecies of *Arthrinium* in Great Britain; it has been collected in this country on *Carex acutiformis*, *C. appropinquata*, *C. elata*, *C. riparia*, *Deschampsia aespitosa*, *Eleocharis palustris* and *Scirpus tabernaemontani*. It can be found all he year round but sporulates most freely from March to May. It grows

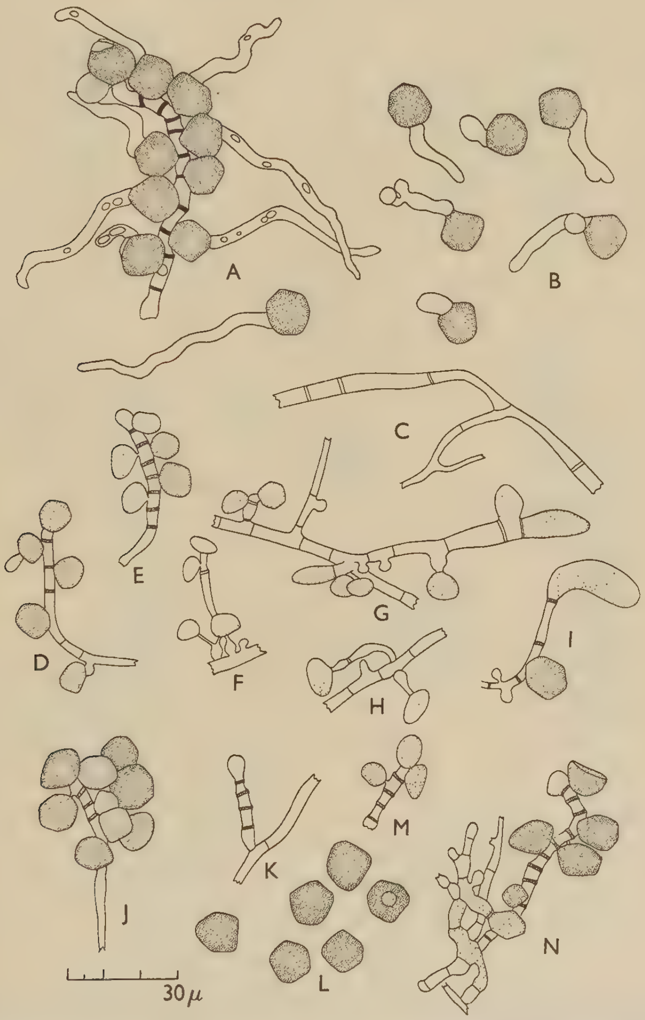


ig. 19. *Arthrinium puccinioides*. A–C and F–H, conidiophores; D, E, parts of the superficial mat, with bases of conidiophores; I, section through a leaf showing embedded mycelium of the fungus and the connexion between this and the superficial mat.

on the dead leaves and causes no localized discoloration of the substratum, lthough the whole leaf on which it grows often has a bleached appearance. The following description is based on Herb. I.M.I. No. 15462, on dead eaves of *Carex riparia*. The colonies are small, usually round and raised, ometimes oval, very dark brown, 70–370 (180) μ in diameter. The mbedded mycelium (Fig. 19 G, I) is composed of hyaline to pale brown, mooth hyphae 1–4 μ in diameter, with cells 4–19 μ long. The superficial mycelial mat (parts of which are illustrated in Fig. 19 D, E) is composed of hyaline to brown, smooth hyphae 3–6 μ in diameter with cells 4–10 μ long. The conidiophores (Fig. 19 A–C, F–H) are simple, narrow, cylindrical, straight or flexuous, 30–130 (70) μ long, 3–13-septate, swollen at the dark brown septa, 2·5–4·5 (3·4) μ in diameter between the septa, smooth; with a hyaline, phialide-like basal cell 3·5–6·5 (4·8) μ wide. The terminal cells (seen in Fig. 19 A, B) are usually round though sometimes polygonal in face view, 6–9 μ in diameter, and more or less hemispherical in side view; they are quite smooth and usually contain one or two highly refractive cubical bodies. Similar cells are sometimes formed laterally (Fig. 19 C, H). Some of the fresh collections made in the summer months, i.e. towards the end of the growing season, bore many cells with inclusions. The conidia are sessile or borne on short hyaline pegs along the sides of the conidiophores between the septa (Fig. 19 C). They are dark brown, thick-walled, smooth, polygonal with rounded corners in face view, 11–14 (12) μ in diameter, hemispherical to triangular in side view. Little variation was seen in the diameter of conidia from thirty-three collections, and there was no significant difference between collections made on different plants at different times of the year. Conidia of *Arthrinium puccinioides* germinate readily in tap water. In 24 hr. each conidium produces a single germ tube 9–90 μ long which is usually simple but occasionally once-branched (Fig. 20 B). Germ tubes are often swollen at the point of emergence to 4–6 μ and they taper down to 2–3 μ. When a conidiophore is placed in tap water the conidia attached to it germinate, but the terminal cells do not (Fig. 20 A). Plates of potato-dextrose agar were inoculated with conidia from Herb. I.M.I. No. 17326*a*, on 27 August 1947; by 12 September thin, cottony, pale brown colonies up to 70 mm. in diameter had been formed. The mycelium, which was partly superficial and partly embedded in the substratum, was composed of branched, hyaline to very pale brown, smooth hyphae 1·5–4 μ in diameter, with cells 8–27 μ long (Fig. 20 C). Occasional pale brown transverse septa were seen. Some of the branches were inflated and up to 10 μ in diameter at their ends (Fig. 20 G), others terminated in or bore laterally short conidiophores (Fig. 20 D–I). On 12 September 1947 transfers were made to potato-dextrose agar slopes and on each of these there was formed, by 3 December, a thin mat of hyaline to pale brown mycelium bearing conidiophores 20–50 μ long with thick, brown, transverse septa, pale brown terminal cells, and conidia similar to those formed on natural substrata and 11–14 (11·9) μ in diameter (Fig. 20 J–N).

(14) **Arthrinium sporophleum** Kunze ex Fries, *Systema Mycologicum*, **3**, 377 (1832).

A. sporophleum grows on newly dead and sometimes on old dead leaves and culms of several species of *Carex*, and is occasionally found on other monocotyledonous plants. Amongst the specimens examined were collections from Great Britain on *C. acutiformis*, *C. hirta*, *C. paniculata*, *C. riparia*, *Eriophorum angustifolium* and *Typha angustifolia*, collections from other European countries on *Carex acuta*, *C. supina* and *Juncus effusus*, and one collection from India on *Eriophorum comosum*. Most of the colonies ound during October and November are young; in these the cells of the uperficial mat are hyaline. The period of maximum growth is from Aarch to April. By May most of the cells of the superficial mat are brown, he colonies have a weathered appearance and there are only a few onidiophores left; giant spores up to 20 by 8 μ are sometimes formed.



ig. 20. *Arthrinium puccinioides.* A, germination of conidia whilst still attached to the conidiophore; B, germinating conidia; C–N, mycelium, conidiophores and conidia from a culture of the fungus on potato-dextrose agar.

n collections made in July many of the conidia were found to be erminating on the surface of the leaf. The following description is based n Herb. I.M.I. No. 19613, on dead leaves of *Carex riparia*. The fungus auses no local discoloration of the substratum. The colonies are compact, val, raised, dark brown, 300–1000 (700) μ by 200–600 (410) μ. The embedded mycelium (Fig. 21 L, M) is composed of hyaline to pale brow smooth hyphae 1·5–4 μ in diameter, which are sometimes brown an swollen to 8 μ in the cells of the epidermis or just below the cuticle; th cells are 6–27 μ long. Cells of the superficial mat (Fig. 21 J, K) ar hyaline to brown, smooth, 3–9 by 4–11 μ. The conidiophores (Fig. 21 A–C

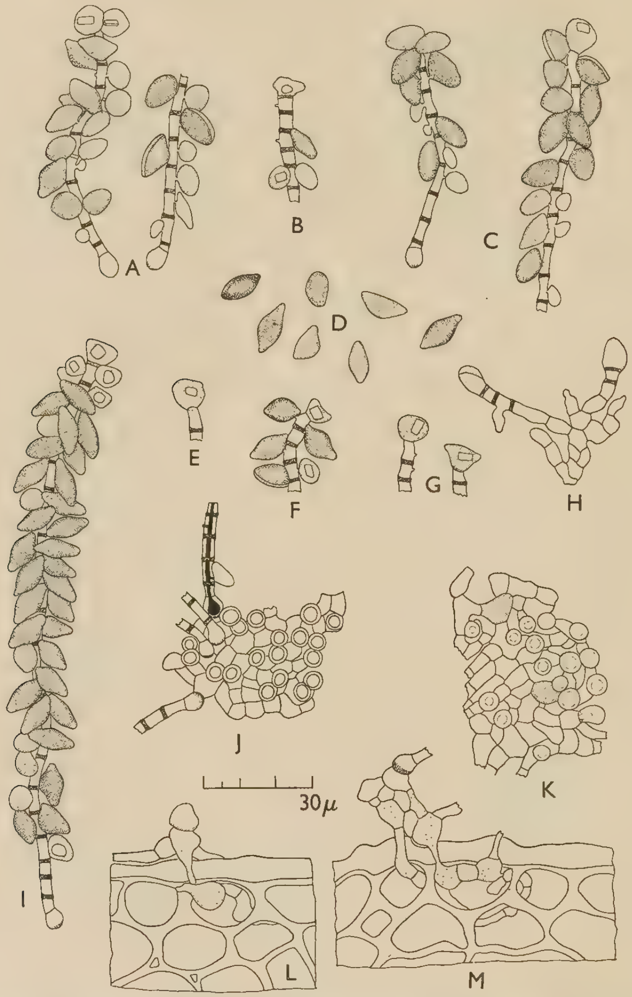
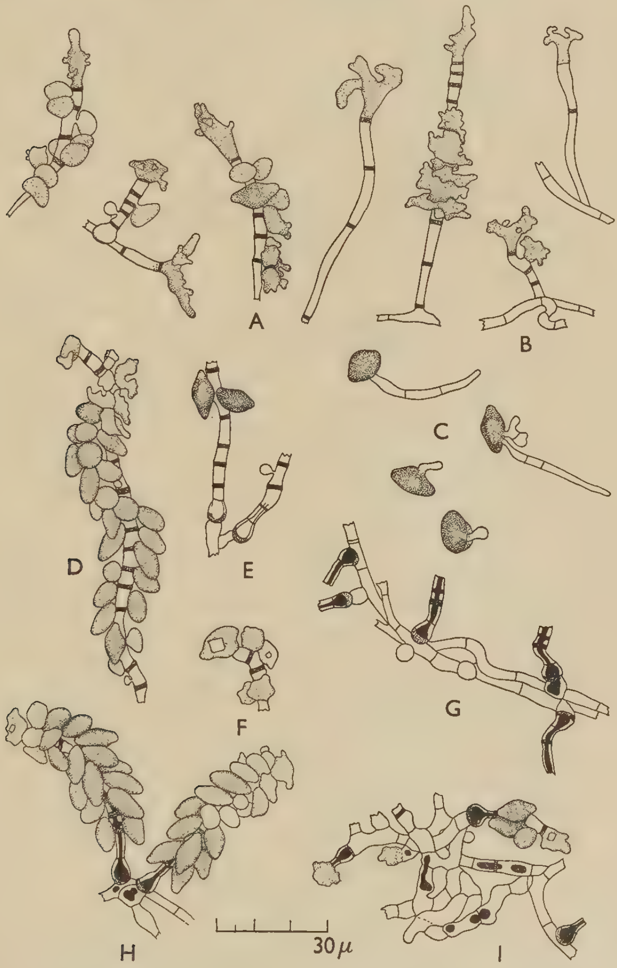


Fig. 21. *Arthrinium sporophleum.* A–C and I, conidiophores; D, conidia; E–G, terminal cell with inclusions; H, young conidiophores; J, K, parts of the superficial mat; L, M, section of leaf showing embedded mycelium linked with the superficial mat.

and I) are narrow, cylindrical, straight or flexuous, smooth, unbranched 42–180 (130) μ long, hyaline, with 5–23 thick, dark brown, transvers septa, 2–4·5 (3·3) μ in diameter between the septa and 5–6 (5·6) μ at th base; the lower part of the phialide-like basal cell is often brown, and th terminal cell (Fig. 21 E–G) is somewhat flattened and round or irregula in shape. The conidia (Fig. 21 D) are sessile or borne on short hyalin egs along the sides of the conidiophore (Fig. 21 A). They are somewhat lattened, lemon-shaped in surface view, often almost triangular in side iew but with the outer edge curved and the corners rounded, brown, ften pale at the tips, smooth, 11–15 (12·3) μ long, 5–7 (5·9) μ wide in urface view. Conidia from forty-one collections were measured. Although



ig. 22. *Arthrinium sporophleum.* A, grown on maize meal agar, from 28 January to 14 February 1948; B, grown on potato-dextrose agar, from 2 to 28 January 1948; C, germinating conidia; D–I, grown on maize meal agar, from 28 January to 26 February 1948.

here is a tendency for conidia to be slightly smaller at the commencement f the growth period this is not constant, and there is no significant ifference between collections made on different substrata at different imes of the year. Conidia germinate readily in tap water forming one, or ccasionally two, hyaline, septate germ tubes (Fig. 22 C). Germ tubes rmed in 24 hr. at laboratory temperature were 5–100 μ long, 2·5–3 μ ide at the point of emergence and 1–2 μ at their tips. No terminal cells were seen to germinate. On 2 January 1948 plates of potato-dextrose agar were inoculated with spores from a fresh collection of the fungus on *Carex riparia* (I.M.I. No. 20967). Growth was slow, but by 28 January the whole surface of the plates, 75 mm. in diameter, was covered. Colonies were white on the surface with occasional grey patches and were grey in reverse. Preparations were made from the superficial grey patches; these were seen to consist of a loose network of branched and anastomosing, septate, hyaline to pale brown hyphae, 2–4 μ in diameter, bearing branches which resembled conidiophores in having brown rings of thickening, but which did not arise from flask-shaped cells or form any conidia (Fig. 22 B). At the ends and along the sides of these branches were borne pale brown, lobed cells which resembled the terminal cells found, in nature, on the conidiophores of *Arthrinium caricicola*. No ordinary conidiophores or conidia were produced in these cultures by 26 February. On 28 January transfers were made to plates of malt extract agar and maize meal agar and to slopes of oatmeal agar. After 1 month on malt extract agar only a woolly, white to pale apricot coloured, purely mycelial growth was formed. On maize meal agar preparations made on 14 February showed structures similar to those found on potato-dextrose agar together with scattered true conidiophores with conidia (Fig. 22 A). Sporulation was taking place freely by 26 February, by which date the whole surface of the 75 mm. plate had been covered. Colonies formed on maize meal agar were white with dark grey patches up to 4 mm. in diameter and uniformly grey in reverse. Drops of colourless fluid were formed above the freely sporing areas. The loose network of mycelium covering most of the surface of the agar was composed of hyaline to pale brown, branched, septate hyphae 2–3·5 μ in diameter, mostly smooth but occasionally rough-walled. In the mat, on which the conidiophores were borne, the hyphae were thicker, 2·5–5 μ in diameter, and they anastomosed freely (Fig. 22 G, I); septa and individual cells were often brown. The conidiophores (Fig. 22 D, E and H) and conidia were similar to those formed on natural substrata but the terminal cells, which on the host plant are regular in outline, were here irregularly lobed and 10–13 by 6–9 μ; many of them contained cubical, highly refractive bodies (Fig. 22 D, F). The conidiophores were 50–130 (100) μ long, 2–4 (3·1) μ in diameter between the septa and 4·5–6·5 (5·6) μ at the base. The conidia measured 10–13 (11·7) μ by 5·5–7 (5·9) μ. Plates of *Carex* agar, freshly inoculated on 24 April 1948, were covered with thin, web-like colonies up to 65 mm. in diameter by 2 June 1948. Small clusters of conidiophores with conidia were formed here and there, mainly around the edge of the Petri dishes.

Papularia

In 1933 Mason suggested that a new tribe, the 'Bivalvae', should be erected to include such genera as *Papularia* and *Arthrinium*, the diagnostic character being the flattened spore attached to the sporophore by one point on its periphery. Studies of British species of *Arthrinium* and *Papularia*, both on natural substrata and in culture, show that these two genera have other characters in common such as the frequent formation of a superficial, close network of interlocked hyphae bearing conidiophores, nd the presence of a swollen, phialide-like cell at the base of each onidiophore. The thick, brown septa which are always found in *rthrinium*, are not present in the two common British species of *Papularia*, lthough in *P. sphaerosperma* from one to three hyaline, highly refractive epta are sometimes seen in the conidiophores (Fig. 24 F). In some ropical species, like *P. vinosa*, the conidiophores often have thick, brown, ransverse septa, although the conidia are of the usual *Papularia* type. The ritish species of *Papularia* are found on many different substrata and ometimes grow together; in *P. arundinis* the conidia are pale brown, sually 5–7 μ in diameter and 3–4 μ thick; in *P. sphaerosperma* they are arker, 9–12 μ in diameter and 5–6 μ thick.

(15) **Papularia arundinis** (Corda) Fries in *Summa Veg. Scand.* Sect. post. 509 (1849).

Gymnosporium arundinis Corda in *Icones Fungorum*, **2**, 1 (1838).

P. arundinis is found frequently on reeds and occasionally on sedges and ther marsh plants. In Great Britain it has been collected on *Agropyron nceum*, *A. repens*, *Arundinaria* sp., *Bambusa* sp., *Carex acutiformis*, *C. riparia*, *ortaderia selloana*, *Cyperus longus*, *Dactylis glomerata*, *Phragmites communis*, and *piraea* sp.; other specimens examined include collections on and cultures solated from *Arundo donax* from Greece, *Carex arenaria* from Belgium, *ryobalanops aromatica* from Java, *Elaeis guineensis* from Malaya, *Musa pientum* from Trinidad, *Nicotiana tabacum* from Nyasaland, *Oxytenanthera byssinica* from Sierra Leone, *Sambucus racemosus* from Germany, *Solanum berosum* from New Zealand, and *Zea mays* from Tanganyika Territory. he fungus sporulates most abundantly in summer and early autumn. he spores have been collected on spore traps set on poles 6 ft. above the round at Wheatfen Broad, Norfolk; they were also present in scum ollected from the surface of the dikes. The following description is based n Herb. I.M.I. No. 29475, on dead culms of *Phragmites communis*. When oung there are numerous small, round, black colonies 50–250 μ in iameter; these later join up to form colonies which encircle the culms and xtend along them for up to 10 cm. The embedded mycelium is hyaline nd composed of hyphae 0·5–1 μ in diameter which pass through the pidermis and outer layers of the cortex (Fig. 23 L). Necol preparations, ashed with acetone and stained with cotton blue, show that there is an xtensive superficial mycelium (Fig. 23 O) forming an open network hich spreads over the surface of the substratum and is closely attached it. In addition, there are numerous round or oval mats of slightly icker and more closely interwoven and coiled hyphae on which the nidiophores are borne (Fig. 23 I, J, M and N). Cells of the open network are hyaline at first, later pale brown, smooth, 1–2 μ in diameter and –18 μ long; mat cells are similar but 2–4 μ in diameter and 4–12 μ long. he conidiophores (Fig. 23 K) are thread-like, hyaline, smooth, simple, d arise from smooth, almost barrel shaped cells, which are hyaline when ung but golden brown on top when old; they are 4–46 (17) μ long, 5–1 μ in diameter, and the basal cells are 4–7 (5·7) μ high and 2·5–5 (3·5) μ wide. The first conidium arises at the apex of the young conidiophore (Fig. 23 I), and the order of formation of conidia along the sides of the conidiophore is primarily from apex to base; on old conidiophores, however, additional young conidia can arise between the mature ones at any level. The conidia are borne on short, hyaline pegs; they are lenticular, smooth, pale brown, with a hyaline rim, 5–7·5 (6·4) μ in diameter and 3–4 (3·6) μ thick. Conidia germinate slowly in tap water (Fig. 23 B); no germination took place in 24 hr., but a number of conidia germinated after 48 hr. each forming a single germ tube which passed out through the rim. Herb. I.M.I. No. 29360*a*, grown on potato-dextrose agar

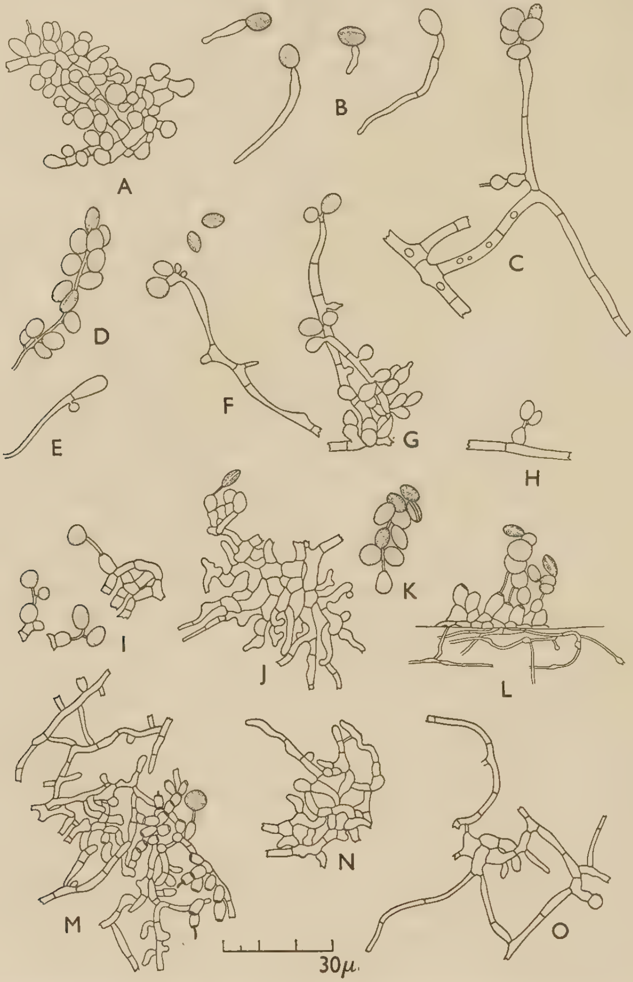


Fig. 23. *Papularia arundinis*. A and C–H, in culture on potato-dextrose agar; I–O, on culms o *Phragmites*. A, G, clusters of short, fat, hyaline cells on which conidiophores develop B, germinating conidia; C, F and H, hyphae with developing conidiophores and conidia D, conidiophore with mature conidia; E, swollen end of a hypha; I, young conidiophores J, M and N, parts of the superficial mycelium (close mat); K, conidiophore showing phialide-like basal cell; L, section showing embedded mycelium; O, part of the superficial mycelium (open network).

rom 15 to 21 June 1948, formed white colonies 70 mm. in diameter with rey strands radiating outwards and small black patches indicating the poring areas. The mycelium was partly superficial and partly embedded n the agar; the superficial weft was thin on potato-dextrose agar but nuch thicker on malt agar. The hyphae were hyaline to very pale brown, mooth, branched, clearly septate, 1–3 μ in diameter, with cells 5–45 μ ong (Fig. 23 C, F and H). In addition to the ordinary long, branched yphae, clusters of short, fat, hyaline to pale brown cells, 4–8 μ and 3–6 μ n diameter were formed (Fig. 23 A, G) on which numerous conidiophores leveloped. As in *P. sphaerosperma*, described in culture by Mason (1933), hialide-like conidiophores were formed on aerial hyphae, these either radually tapered to the apex or, more frequently, became very fine and hread-like immediately above the basal cell (Fig. 23 H). Many hyphae nded in conidiophores (Fig. 23 C). The conidiophores (Fig. 23 D), formed aterally on branches of the mycelium, usually had a basal cell 4–6 μ long nd 2–4 μ wide; they were thread-like, hyaline, smooth, unbranched, ccasionally septate but indistinctly so as a rule, 0·5–1 μ in diameter and –45 μ long. The conidia were attached at the rim by short hyaline pegs; hey were 6–7 (6·2) μ in diameter and 3·5–4 (3·7) μ thick.

(16) **Papularia sphaerosperma** (Pers. ex Fr.) von Höhnel in *Fragmente zur Mykologie*, No. 990 (1916).

Stilbospora sphaerosperma Persoon in Usteri's *Ann. di Botan.* 15 Stück, 31 (1795).
Melanconium sphaerospermum (Pers.) Link in *Linn. Spec. Plant.* Ed. 4, 6, Pt. 2, 91 (1825); Fries, *Systema Mycologicum*, **3**, 489 (1832).

P. sphaerosperma grows on dead leaves and culms of grasses and on umerous other substrata. During its period of maximum growth, in uly and August, the fungus is especially conspicuous on the culms of *hragmites communis* where it breaks out in long black lines and many ollections have been made on this host plant; it also occurs in marshes nd fens on *Calamagrostis canescens*, *Glyceria maxima*, *Cladium mariscus*, *Carex cutiformis*, *C. riparia*, *Phalaris arundinacea*, and *Valeriana officinalis*, and in ther habitats in this country on *Arrhenatherum elatius*, *Arundinaria* sp., *ambusa* sp., *Cortaderia selloana* and *Pteridium aquilinum*, sometimes associated vith *P. arundinis* and was found once under snow on the upper side of large, fallen, decorticated trunk of *Acer campestre*; it has been isolated om the soil, from swede seeds and citrus fruits, and is easily grown on all rdinary media such as potato-dextrose, malt and maize meal agars. *apularia sphaerosperma* is world-wide in its distribution, and specimens ave been examined on *Bambusa* from Cyprus and the Philippines, *hyllostachys* from Japan, maize from Kenya, tobacco from Nyasaland, *anicum maximum* from Tanganyika Territory, wheat from U.S.A., and *hragmites* from Italy, Germany and Southern Rhodesia. The growth and ppearance of the fungus, both on the host and in culture, is variable. On aves of *Carex* (Fig. 24 G, H and I), *Glyceria* and *Phragmites*, and on ecorticated wood, it forms small, round to oval humps, 100–500 μ in iameter, which are superficial; on leaves of *Cladium mariscus* and on most ulms fructification commences beneath the epidermis which later splits longitudinally to expose the shiny black spore masses. In culture conidia are formed at the ends of ordinary branches of the mycelium, on narrow conidiophores which arise laterally on those branches, and on similar conidiophores formed on clumps of short, closely intertwined and

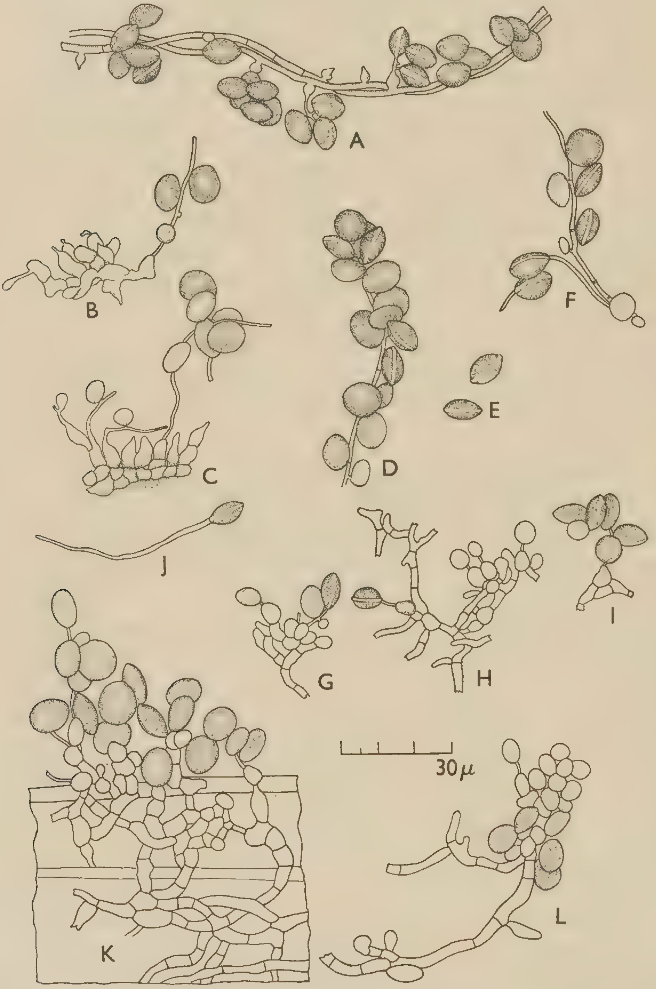


Fig. 24. *Papularia sphaerosperma.* A, hyphae with conidiophores and conidia from a culture o potato-dextrose agar; B, C, groups of cells from which conidiophores develop; D, F conidiophores; E, conidia; G, H and I, parts of the superficial mat from leaves of *Carex* J, germinating conidia; K, section through *Phragmites* culm showing part of the embedde mycelium and conidiophores growing up above the surface; L, part of the superficial ma on *Phragmites.*

thickened hyphae. There is a phialide-like cell at the base of each of th thread-like conidiophores. On culms of *Phragmites* new growth commences as a rule, late in June or at the beginning of July; in some years, as in 194 when many flowering plants blossomed before their time, young materia s found in May. Longitudinal sections of the culms show that there is very extensive system of branched, hyaline, septate mycelium which asses between the vascular bundles, extends along and through the ortex and forms groups of thick, closely interwoven hyphae just below the pidermis; on the latter are produced large numbers of phialide-like cells ut of which develop the narrow conidiophores. The epidermis is raised nd finally splits, one to three cracks appearing parallel to the long axis of he culm. In this state the fructification, which is usually 2–3 mm. long nd 0·5 mm. wide, has been treated as an acervulus and the fungus ncluded in the genus *Melanconium*. Later, in July and throughout August, he fungus continues to grow and produce more spores, the conidiophores re raised above the surface of the substratum (Fig. 24 K) and the colonies ecome enlarged up to 5 by 1 mm.; in addition small, round, superficial nats are often formed, and fresh conidiophores arise on thick cells grouped ogether in quite an open network (Fig. 24 L). From September onwards nore and more conidia are lost and fewer fresh ones formed, and by ecember the fungus is flattened and has a washed-out appearance. ructifications with a few conidia last right through to July of the following ear on old dead culms. The following description is based on Herb. .M.I. No. 29457, on dead culms of *Phragmites communis*. The colonies are lack, 1–3 by 0·5 mm., with the conidiophores closely packed together. he embedded mycelium is composed of hyaline, smooth to verruculose yphae, 1–4 μ in diameter, with cells 5–40 μ long (Fig. 24 K). The cells f the superficial mats are hyaline at first, later pale brown, smooth-walled, –6 μ in diameter and 4–12 μ long (Fig. 24 L). The conidiophores Fig. 24 B–D) are narrow, thread-like, hyaline, smooth, simple, 5–63 (30) μ ong and 0·5–1 (0·9) μ in diameter, with 0–3 septa; basal cells are usually void or conico-truncate, hyaline when young, later pale brown, smooth, –8 (5·9) μ high and 3–5 (4·4) μ in diameter. The conidia (Fig. 24 E) are enticular, smooth, dark golden brown with a hyaline rim by transmitted ight, black and shining in mass by reflected light, 9–12 (10) μ in diameter nd 5–6 (5·6) μ thick. Little variation was seen in the measurements of onidia from twenty-three other collections. One conidium is formed at he apex of the conidiophore, others are attached to it laterally by short egs; most of the younger conidia are near the base of the conidiophore ut they may develop at any point along it, and young and old conidia re often found together at the same level. The conidia germinate readily n tap water forming, in 24 hr., a single germ tube 1–1·5 μ in diameter and 35–75 μ long (Fig. 24 J). Germination takes place at the rim and the two alves open slightly. Herb. I.M.I. No. 17324, grown on potato-dextrose gar from 10 July to 10 August 1948, formed white, cottony colonies 90 mm. n diameter, with buff patches and small, black sporing areas, and buff in everse. The mycelium was partly embedded in the substratum and partly uperficial; the hyphae were hyaline to pale brown, smooth, 1·5–4 μ in iameter, with cells 7–40 μ long. There were also clusters of pale brown, arrel-shaped cells, 4–8 μ long and 3–6 μ in diameter; these were, usually t least, partly embedded in the agar. The conidiophores either terminated ranches of the mycelium or arose laterally on them (Fig. 24 A); they lso arose from the barrel-shaped cells. Lateral conidiophores usually had a phialide-like basal cell which was 3–6 μ long and 2·5–4·5 μ in diameter; they were hyaline, thread-like, 0·5–1 μ in diameter and 9–35 μ long. The conidia were 8–10 (9·2) μ in diameter and 5–6 (5·7) μ thick.

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SOIL-STEAMING: A SELECTIVE METHOD FOR THE ISOLATION OF ASCOMYCETES FROM SOIL

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During an investigation into the occurrence of fungi in soil partially sterilized by steam, it was found that whereas many fungi were easily killed, other species had resistant spores and survived a short steam treatment. Many of these species were rarely recorded from untreated soil, being apparently suppressed by the abundant development of fast-growing fungi. Ascomycetes in particular were isolated from soils after a short steam treatment, and several species, including *Aspergillus fischeri*, *Penicillium luteum* and *P. baarnense*, were found to be more abundant and widespread in soils than hitherto recorded.

One of the problems of soil microbiology has always been to estimate how arge a proportion of the organisms which occur in soil are isolated by known techniques. The dilution plate method has been extensively used to solate fungi from soil, and a wide range of genera, particularly of the Mucorales and Fungi Imperfecti, has been isolated by that method. It is recognized, however, that certain groups of fungi known to occur in soil are seldom, if ever, recorded by plating techniques (Waksman, 1944). Chesters (1949), in his recent review on soil fungi, mentions *Pythium*, the darker coloured Hyphomycetes, and the larger Ascomycetes and Basidiomycetes as being among these groups. Special 'baiting' techniques have demonstrated the presence of particular groups of fungi in soil. The presence of root-disease organisms in soil has been shown by baiting with a suitable plant host (Garrett, 1944), Saprolegniaceae and allied watermoulds have been recorded by baiting soil and water cultures with hemp seed (Butler, 1907; Chesters, 1949), and predacious fungi have been solated by adding soil or humus to agar plates infested with nematodes or amoebae (Drechsler, 1941). Recently the writer has been able to show that ower Ascomycetes are abundant in many soils and are more widespread than hitherto recorded.

SOIL-STEAMING AS A METHOD FOR THE ISOLATION OF FUNGI FROM SOIL

During an investigation of fungus recolonization of soil partially sterilized by steam, it was noted that certain fungi were able to survive a mild application of the treatment. Table 1 records the fungi isolated from Kettering loam, samples of which had been treated with steam for different periods of time. 125 g. samples of soil in glass tumblers were placed in a steamer at 100° C. for periods of 0, 2, 4, 6, 8 and 10 min. After treatment, he surface soil was removed to a depth of 1 cm., and ten soil plates Warcup, 1950) were prepared from the soil in each tumbler. Dox + yeast extract, acidified with phosphoric acid to pH 4·0 was used as the isolation medium.

Steaming the soil for 2 min. caused little change in the fungus flora. A 4 min. steaming period, however, reduced the number of species markedly, and longer steaming periods destroyed almost all the fungi i this soil. The change in the fungus flora brought about by steaming fo 4 min. was twofold: whereas many species were either killed or reduced i numbers, other fungi, many of which had not been recorded from untreated soil, were found to be abundant on the plates. Ascomycetes, in particular, survived a short steam treatment, and of seven species recorde from Kettering loam, six were isolated only from steam-treated samples.

Table 1. *Effect of soil-steaming on the isolation of fungi from Kettering loam*

(Occurrence on ten soil plates.)

Fungus	Length of treatment (min.)					
	0	2	4	6	8	10
Pythium sp.	4	—	—	—	—	—
Absidia cylindrospora Hagem	10	10	—	—	—	—
Mortierella spp.	10	6	—	—	—	—
Mucor spp.	7	5	—	—	—	—
Zygorrhynchus vuillemini Namysl.	8	5	—	—	—	—
Fusarium culmorum (W. G. Smith) Sacc.	3	1	—	—	—	—
Penicillium A	6	7	—	—	—	—
P. frequentans Westling	5	4	—	—	—	—
**Sordaria* sp.	1	4	2	—	—	—
Penicillium B	8	10	2	—	—	—
Penicillium C	10	10	2	—	—	—
Penicillium B14	4	3	7	—	—	—
P. nigricans (Bainier) Thom	10	8	9	—	—	—
Trichoderma viride Pers. ex Fr.	9	9	1	—	—	—
Aspergillus versicolor (Vuill.) Tiraboschi	1	2	1	2	—	—
Fusarium oxysporum sensu Snyder & Hansen	10	10	1	1	—	—
Penicillium purpurogenum Stoll	1	2	5	2	—	—
Aspergillus fumigatus Fres.	—	1	5	—	—	—
**A. amstelodami* (Mang.) Thom & Church	—	—	3	—	—	—
**Gymnoascus subumbrinus* A. L. Smith & Ramsb.	—	—	5	—	—	—
**Gymnoascus* B93	—	—	8	—	—	—
Penicillium D	—	—	6	—	—	—
**P. luteum* Zukal	—	—	7	—	—	—
**P. wortmanni* Klöcker	—	—	7	—	—	—
**P. ehrlichii* Klebahn	—	—	9	8	—	—
Total no. of species isolated	31	32	22	5	1	1

* Ascosporic species.

Further steamed samples have confirmed these results, showing tha certain fungi, including a high proportion of Ascomycetes, possess spore which are resistant to a short steam treatment. Many of these fungi wer comparatively slow-growing organisms, which were favoured by the smal number of colonies which developed on the plates. They were rarel recorded from plates prepared from untreated soil, being suppressed b fast-growing fungi such as *Mucor*, *Absidia*, *Mortierella*, *Zygorrhynchus* an *Trichoderma*.

ASCOMYCETES ISOLATED FROM STEAM-TREATED SOILS

About sixty soil samples, from a wide range of localities throughout th British Isles, have been steamed for the isolation of Ascomycetes. Three t five minutes were found to be the most useful steaming periods. I general, heavy soils, or soils with a high proportion of humus, require a longer period of steaming than light sandy soils. Ascomycetes were abundant in some soil samples and were not recorded from other samples. All deciduous woodland soils so far tested have yielded very few Ascomycetes, whereas some garden and agricultural soils have shown comparatively high numbers of colonies and species of these fungi.

The fungi most frequently isolated by this method included ascosporic Penicillia and Aspergilli and related genera. Species of *Chaetomium* and Sordariaceae were less frequently isolated. Besides these Ascomycetes, everal other fungi, including *Absidia lichtheimii* (Lucet & Costantin) Lendner, non-ascosporic *Penicillium* spp., and *Aspergillus fumigatus* Fres., were frequently isolated from steamed soil.

A. fischeri Wehmer, with twenty-four records, was the commonest Ascomycete recorded from the soils sampled. This species was rare in woodland soils, but was frequently isolated from agricultural and grassland oils, both acid and alkaline. Thom and Raper (1945) have recorded *A. fischeri* as world-wide in distribution but not apparently abundant anywhere. Members of the *A. glaucus* group, including *A. amstelodami* (Mang.) Thom & Raper, *A. repens* (Cda.) de Bary, and *A. umbrosus* Bainier & Sartory, were of frequent occurrence in agricultural soils. They may have been more abundant than recorded, because many isolates grew poorly on the isolation medium (Dox containing 3 % sucrose), and Thom & Raper (1945) have shown that species of the *A. glaucus* group prefer media with a high sugar content.

Chaetomium species, including *C. funicola* Cooke, *C. indicum* Corda, and *C. globosum* Kunze, were occasionally isolated but did not seem to be particularly favoured by soil steaming.

Gymnoascus subumbrinus A. L. Smith & Ramsb. was occasionally isolated from alkaline or near-neutral soils. Warcup (1951) has also recorded this species as common in untreated alkaline soils at Lakenheath Warren.

Eight species of ascosporic Penicillia were isolated from steamed soil samples. *Penicillium luteum* Zukal and *P. baarnense* van Beyma were the commonest species in British soils, though these species have seldom before been recorded (Raper & Thom, 1949). *P. luteum* (sixteen records) was common in grassland and garden soils, and has not yet been recorded from highly acid soils. Warcup (1951) also found this species to be common in untreated alkaline soils at Lakenheath Warren. *P. baarnense* (fourteen records) occurred predominantly in grassland soils. Other species isolated nclude: *P. ehrlichii* Klebahn (five records) from forest nursery and grass- and soils; *P. striatum* Raper & Fennell, once from highly acid pinewood soil; *P. spiculisporum* Lehman (three records); *P. vermiculatum* Dangeard, (eight records); and *P. wortmanni* Klöcker (seven records). Raper and Thom (1949) record *P. vermiculatum* and *P. wortmanni* as abundant in nature and world-wide in distribution.

Thielavia sepedonium Emmons was recorded from three agricultural soils and several other Ascomycetes, whose taxonomic position is still doubtful, were also recorded from steam-treated soils.

Cultures of all the ascosporic Penicillia recorded in this paper have been deposited at the herbarium of the Commonwealth Mycological Institute.

This account forms part of an investigation on the effect of partia sterilization on the fungus flora of the soil, made possible by a grant from the Agricultural Research Council, to whom I make grateful acknowledgement. I also express thanks to Dr K. B. Raper for assistance with the identification of Penicillia, and to Prof. F. T. Brooks and Dr S. D. Garret for continued encouragement.

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Dr R. F. Cain, University of Toronto, has kindly identified some isolate from steam-treated soil. They include *Perisporium funiculatum* Preuss *Sordaria fimicola* (Rob.) Ces. & de Not., *S. setosa* Wint. and *Gelasinospor cerealis* Dowd.

EFFECT OF PARTIAL STERILIZATION BY STEAM OR FORMALIN ON THE FUNGUS FLORA OF AN OLD FOREST NURSERY SOIL

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(With Plate 25, and 3 Text-figures)

Treatment with steam or formalin markedly affected the fungal flora of an old forest nursery soil. The untreated nursery soil contained two soil layers, the lower of which was characterized by a very poor fungus flora. Some fifty-five species were of frequent occurrence in untreated soil, and common genera in the upper layer were *Pythium*, *Absidia*, *Mortierella*, *Mucor*, *Aspergillus*, *Fusarium*, *Gliocladium*, *Penicillium*, *Phoma* and *Trichoderma*. Both with steam or with formalin treatment, fungi were initially destroyed or reduced to very low numbers. The penetration of soil by different treatments was 16 in. for Hoddesdon steaming, 8 in. for Canopy steaming, and 5 in. for formalin treatment.

Fungal recolonization of treated soil was very slow, and even 18 months after treatment numbers of species and colonies were much lower than in untreated soil. Steam-treated soil was recolonized chiefly by species of *Mortierella*, *Phoma eupyrena* and *Coniothyrium* sp. in the first year. These species, with *Penicillium* spp. and sterile fungi, were present in the second year after treatment. Recolonizing fungi were usually most abundant near the soil surface. In formalin-treated soil *Trichoderma viride* was the dominant recolonizer. *Phoma eupyrena*, *Coniothyrium* sp. and *Fusarium* spp. were also present, particularly in the second year. Fewer species recolonized formalin-treated soil than steam-treated soil.

Mean height and total number of Sitka spruce seedlings grown on the experimental plots were appreciably increased by soil sterilization with steam or formalin.

INTRODUCTION

he beneficial effects on plant growth of the partial sterilization of soil by eam or by volatile disinfectants have been known for many years. The oil processes involved, however, are very complex, and partial sterilization known to affect the physical properties of the soil, to increase the soluility of many nutrients, and to cause profound changes in the microflora nd fauna. The literature of partial sterilization, and particularly of its icrobiological aspects, has been reviewed by Waksman and Starkey 1923) and more recently by Hall and Clegg (1949).

A large proportion of the fungi in the soil is killed by partial sterilization eatments, the number destroyed depending on the treatment and the ose (Matthews, 1924; Tam & Clark, 1943; McCool, 1945; Martin, 1950). aksman and Starkey (1923) found that toluene or heat markedly educed numbers of fungi, but that they soon developed again and reached umbers greatly in excess of those in untreated soil. After reaching maximum, numbers fell to normal. This initial depression, followed by rise in numbers of fungi after partial sterilization, has also been reported y many subsequent workers (Tam & Clark, 1943; McCool, 1945; artin, 1950). Katznelson and Richardson (1943), however, noted that whereas chloropicrin or formalin resulted in large increases in number of fungi, steam appeared to exert a deleterious influence even afte 3 months.

Waksman and Starkey (1923) noted also that the fungi developing in partially sterilized soil were limited to a few species only. Katznelson and Richardson (1943) found that certain species of *Penicillium* and *Plecto* *naemella* increased in numbers in some soils after partial sterilization with steam and formalin respectively. Smith (1939) noted that after treatmen of soil with low concentrations of chloropicrin, the fungal flora which developed consisted mainly of *Trichoderma*. Tam and Clark (1943) found that chloropicrin or formalin treatment of soil favoured species of *Asper* *gillus* and *Penicillium*, but steam treatment eliminated nearly all fung except *Trichoderma*. Ludwig and Henry (1943) observed that reinoculated steam-treated soil contained large numbers of *Trichoderma*. The development of this fungus was thought to be an important factor in the reduced severity of attack of wheat seedlings by *Ophiobolus graminis*. Martin (1950) found that whereas relatively few species of fungi developed after partial sterilization treatments, the numbers and species established varied greatly even between replicates of the same treatment. His results led him to believe that it would be difficult to predict the effect of various partial sterilizing agents on the exact nature of the fungal population of the soil

Many of these conclusions concerning the effect of partial sterilizing agents on the fungal population of soil have been derived from experiments in the laboratory, and it is not known if they are valid in the field, where conditions for fungal recolonization of treated soil differ from those operating in the laboratory. This paper records the results of an examination of changes in the fungal flora of an old forest nursery soil after partial sterilization with steam or formalin. The work was carried out at the Old Ampthill Nursery, Bedfordshire, belonging to the Forestry Commission.

The old nursery at Ampthill has been in use for raising tree seedlings for about 25 years, during which time the ground was only occasionally green cropped, and in recent years conifer seedlings have shown very poor growth. Fertilizers by themselves have had little effect on increasing the productivity of many such old nursery soils, whereas it is much increased by partial sterilization (Crowther, 1950). The soil is derived from drif over Greensand, and is composed of an upper layer of grey sand, 0–10 in deep; a lower layer of orange sand, 12–(14–24) in. deep; below which is consolidated Greensand. The layer of orange sand is very poor in organic constituents and sesquioxides. The pH value varies throughout the nursery but is 6·8–7·2 in the surface layers of the experimental area.

EXPERIMENTAL PLOTS AND THEIR TREATMENTS

In March 1949, six plots were set out, two for treatment by steam, two fo treatment by formalin, with two untreated plots. The plots were 16 × 15 ft. with 3 ft. alleys between them. Each plot contained three seed-beds, each 16 × 3·5 ft. with 1·5 ft. paths between the beds. All plots were given similar cultivation treatments. Steaming was done by the Hoddesdon method with the pipes buried to a depth of 9–10 in. Steaming time wa 15 min. at 100° C. (surface temperature) under a tarpaulin cover ormalin was applied as a drench at the rate of 1 gallon of 4 % solution er sq.yd. In all cases sterilization treatments were applied to whole plots nd not to individual seed-beds. Plots were sown with Sitka spruce (*Picea tchensis* Carr.) 3 weeks after treatment.

In 1950, part of each of the 1949 plots was resown with Sitka spruce ithout further sterilization treatment. The original treatments were also epeated on fresh areas in 1950, but with smaller experimental plots, ·5 × 8 ft., each containing one seed-bed. A further treatment was added, wo plots being steamed with a Canopy type steamer. The steaming time as 15 min., and high temperatures were reported for the top 4 in. of il, but below this level temperatures did not much exceed 40° C.

COLLECTION OF SOIL SAMPLES AND ISOLATION OF FUNGI

oil samples were collected about 2·5 ft. apart and 3 ft. from the edge of plot (a standard distance from the edge of the treatment). A soil profile as exposed by digging a pit about 6 in. square and to the depth of the onsolidated Greensand (14–24 in.). The earth removed from a pit was laced on a cloth and later used to refill the hole; in this way it was ossible to avoid disturbing the seed-beds unduly. One face of the pit as prepared as the profile, and small sterilized specimen tubes were ushed horizontally into the face at successive 1 or 2 in. intervals. Samples ere collected every inch to 10 in. (upper soil layer) and thereafter every econd inch (lower soil layer). Usually only one profile sample was ollected from a plot on any given sampling occasion, since it was found at fungal floras from samples from duplicate plots gave as good an greement as those obtained from replicate samples from the same plot.

Soil plates for isolation and study of soil fungi were prepared in triplicate om each small sample of soil. Acidified Dox + yeast extract agar was sed as the isolation medium (Warcup, 1951 *a*).

FUNGI ISOLATED FROM AMPTHILL SOIL

ver 140 species of fungi were recorded from Ampthill nursery soil, and bout fifty-five of these were of frequent occurrence in the untreated soil.

Phycomycetes were represented by eleven genera and thirty-five species. *ortierella* was the most abundant Phycomycete, but *Pythium*, *Absidia* and *ucor* were also prominent. Although zygospores were obtained for most ecies of *Absidia* and for *Mucor hiemalis*, they were comparatively rare on il plates. A *Syncephalis* sp. parasitizing *Mortierella* species became bundant in steamed plots but was not recorded from untreated soil.

Ascomycetes were represented by nine genera and eighteen species. ome Ascomycetes were more abundant in steamed than in untreated soil.

Four Basidiomycetes were isolated, and were more frequently recorded om steam-treated than from untreated soil. The writer hopes to present is data on these fungi in a later paper.

As is typical in soil isolations, most of the fungi isolated must be placed the Fungi Imperfecti. Some species were abundant, others were olated only once. Prominent genera were *Aspergillus*, *Fusarium*, *Gliocladium*, *enicillium*, *Phoma*, *Stemphylium* and *Trichoderma*. A nematode-catching *rthrobotrys* was recorded both from nematode-infested and nematode-free soil plates. Identifications were not obtained for forty of the isolate including twenty-nine which were sterile on all media tested.

The following list of species records names or collection numbers fungi isolated from the nursery soil. All species marked † were speci which were isolated from more than half of the profile samples fro untreated soil. Besides the species listed, six of the unidentified fungi we also common. Names given in brackets are tentative identifications species deposited at the Commonwealth Mycological Institute are marke by an asterisk.

List of species

PHYCOMYCETES

†Pythium (acanthicum?) Drechsler
P. dissotocum Drechsler
†P. ultimum Trow
Pythium: 3 species
*Absidia butleri Lendner
A. cylindrospora Hagem
*†A. glauca Hagem
†A. lichtheimi (Lucet & Constantin) Bainier
A. orchidis (Vuillemin) Hagem
A. spinosa Lendner
Actinomucor repens Schostakowitsch
Coemansia (pectinata?) Bainier
Cunninghamella elegans Lendner
†Mortierella alpina Peyronel
M. isabellina Oudemans
†M. vinacea Dixon-Stewart
Mortierella: 4 species
Mucor hiemalis Wehmer
M. mucedo (Linne) Brefeld
M. racemosus Fresenius
M. ramannianus Möller
M. spinosus van Tieghem
Mucor: 3 species
Pilaira anomala (Cesati) Schroeter
Rhizopus microsporus van Tieghem
Syncephalis E69
Zygorrhynchus heterogamus Vuillemin
*†Z. vuillemini Namyslowski

ASCOMYCETES

*Amauroascus verrucosus Eidam
Aspergillus fischeri Wehmer
†A. nidulans (Eidam) Wint.
A. repens (Cda.) de Bary
A. umbrosus Bainier & Sartory
*Gymnoascus subumbrinus A. L. Smith & Ramsb.
Gymnoascus E86
*Penicillium luteum Zukal
*†P. vermiculatum Dangeard
*†Thielavia sepedonium Emmons
*Cainea verruculosa (Jensen) Hughes ined.
*Chaetomium funicola Cooke
*†C. globosum Kunze
*C. indicum Corda
*C. murorum Corda
*Melanospora B68
Sordaria fimicola (Rob.) Ces. & De Not.

FUNGI IMPERFECTI

*†Acrostalagmus cinnabarinus Corda
Aleurisma carnis (Brooks & Hansf.) Bisby
Alternaria tenuis auct.
Arthrobotrys E129
*†Aspergillus fumigatus Fres.
A. niger van Tieghem
A. oryzae (Ahlburg) Cohn
A. terreus Thom
A. (terricola?) Marchal
*†A. versicolor (Vuill.) Tiraboschi
†A. (versicolor series)(B23)
†Cephalosporium E74
†Cladosporium herbarum Link
†Coniothyrium E63
†Cylindrocarpon radicicola Wollenw.
*†Fusarium culmorum (W. G. Smith) Sacc
*†F. equiseti (Corda) Sacc.
†F. oxysporum sensu Snyder & Hansen
*†F. sambucinum Fuckel
†Gliocladium fimbriatum Gilman & Abbo
†G. roseum (Link) Bainier
†Gliocladium E34
*†Gliomastix convoluta (Marchal) Mason
Helminthosporium E137
†Humicola grisea Traaen
Oidiodendron fuscum Robak
†Paecilomyces B5
*Papularia arundinis (Corda) Fr.
*†Penicillium frequentans Westling
†P. granulatum Bainier
*†P. janthinellum Biourge
†P. jenseni Zaleski
P. (kapuscinskii?) Zaleski
*†P. lilacinum Thom
*†P. nigricans (Bainier) Thom
†P. (restrictum?) Gilman & Abbott
*†P. spinulosum Thom
Penicillium: 4 species
†Pestalotia E61
*†Phoma eupyrena Sacc.
Phoma E127
Pullularia pullulans (de Bary & Low) Berkhout
Monilia geophila Oudemans
Myrothecium sp.
Sclerotium E84
*Stachybotrys atra Corda
†Stemphylium consortiale (Thüm.) Groves Skolko
†Stysanus E36
†Trichocladium asperum (Cda.) Harz
†Trichoderma viride Pers. ex Fr.
†Volutella ciliata Fr.

DISTRIBUTION OF FUNGI IN PROFILES OF UNTREATED SOIL

The average number of species from a profile of untreated nursery soil was fifty-four, a high figure in comparison with figures recorded for natural grassland soils (Warcup, 1951*a*). Most species were isolated from the upper 10 in. of soil, and below that depth many fewer species were found Text-fig. 1). Many of the common surface genera and species, including *Pythium*, *Fusarium*, *Mucor*, *Absidia* and *Stemphylium*, were rarely, if ever, recorded below a depth of 10–12 in. This division of the fungal flora is closely correlated with the two layers in the nursery soil.

There was little evidence of seasonal distribution in the occurrence of ungi, and most species showed a random distribution throughout the upper oil layer. This may be partly an effect of cultivation as compared with natural soils (Warcup, 1951*a*). In the lower soil layer the number of ungi, species and colonies, diminished gradually with increasing depth. Table 1 records the percentage occurrence of some of the commoner pecies on all soil plates prepared from untreated soil; percentage occurrence has been assessed separately for upper and lower soil layers, each igure being based on a count of 723 soil plates (upper) and 282 soil plates lower).

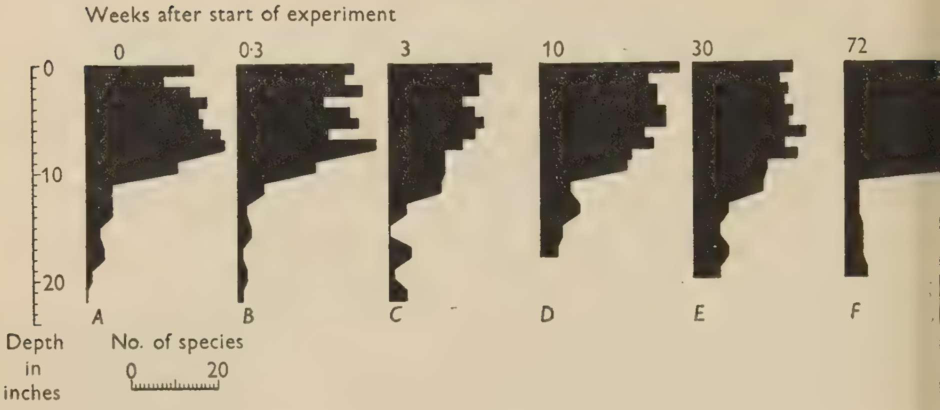
Table 1. *Percentage occurrence of commoner fungi in upper and lower layers of untreated nursery soil*

Top layer	Percentage occurrence	Lower layer	Percentage occurrence
Penicillium nigricans	91	Penicillium (restrictum?)	44
Phoma eupyrena	91	Mortierella alpina	24
Trichoderma viride	90	Penicillium janthinellum	20
Gliocladium roseum	80	Coniothyrium E63	17
Coniothyrium E63	76	Aspergillus B23	14
Fusarium oxysporum	76	Trichoderma viride	14
Penicillium spinulosum	60	Penicillium nigricans	12
Stemphylium consortiale	52	Gliomastix convoluta	11
Mortierella E31	44*	Gliocladium roseum	8
Mortierella E32	44*	B1	8
Humicola grisea	41	Penicillium (kapuscinskii?)	8
Gliomastix convoluta	35	Paecilomyces B5	7
Gliocladium E34	35		
Fusarium culmorum	34		

* These figures represent an average as these two fungi were not always distinguished eparately.

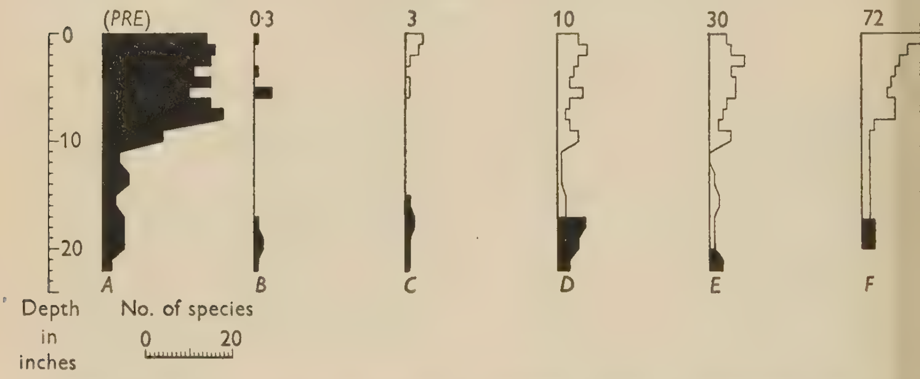
Table 1 shows that the lower soil layer has a restricted fungal flora in omparison with the upper layer. In the complete list, of which Table 1 s an abridgement, thirty-three species showed occurrence figures higher han 10% in the surface layer, whereas only eight reached this frequency n the lower layer. Fungi were also absent from 14% of the soil plates repared from the lower layer, but none of the plates prepared from the pper soil layer remained sterile. Several of the common species in the ower layer also occurred more abundantly in the surface soil. *Penicillium* (*restrictum*?), *P. janthinellum*, B1, *Paecilomyces* B5, *Penicillium* (*kapuscinskii*?) nd *Aspergillus* B23 were the only species found more frequently in the ower layer than in the surface soil, and the last four were only locally bundant. Another factor which makes it difficult to decide whether the

Untreated soil



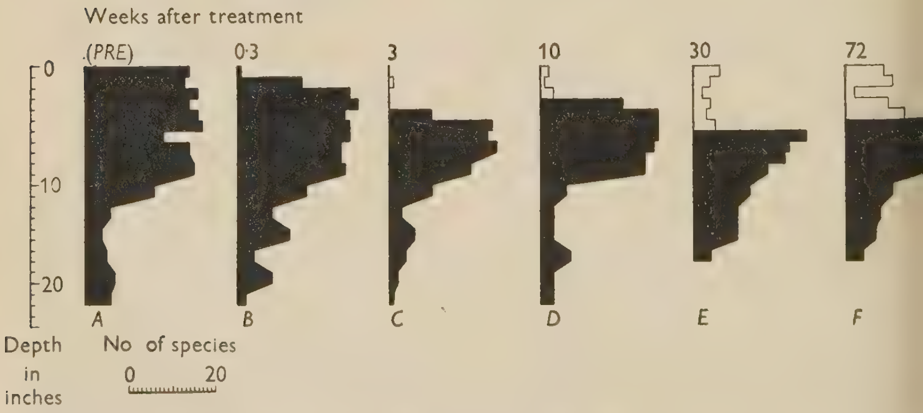
Text-fig. 1. Distribution of species of fungi in successive samples of untreated forest nursery soil.

Plot 6. Steam-treated soil



Text-fig. 2. Distribution of species of fungi in successive samples of forest nursery soil after Hoddesdon-steam treatment. The distribution of species recolonizing treated soil is unshaded.

Plot 3. Formalin-treated soil



Text-fig. 3. Distribution of species of fungi in successive samples of forest nursery soil afte formalin treatment. The distribution of species recolonizing treated soil is unshaded; note th variation in depth of penetration of treatment in different profiles.

wer soil layer has a distinct fungal flora is that many of its members e relatively slow-growing species which may be more abundant in the rface soil than actual records indicate, i.e. because they are suppressed faster growing species. Many of the lower layer fungi have, however, en recorded from lower horizons of the soils of Lakenheath Warren Varcup, 1951*a*).

While the 'abundant' fungi recorded in Table 1 are, with few exceptions, ecies which spore heavily in culture, it must be remembered that many the rarer species fruit equally well in culture. It seems unlikely therefore at sporing capacity alone determines abundance of soil fungi and suggests at the 'abundant' fungi are, or have been, favoured by the soil conditions the nursery. However, in the present state of our knowledge of soil icro-organisms, it is impossible to estimate how important these commonly isolated fungi are in soil processes, and some of the rarer species, rticularly those which spore infrequently, may be equally important in e complex mechanisms of decomposition and plant growth in the soil.

MICRO-ORGANISMS OTHER THAN FUNGI RECORDED FROM NURSERY SOIL

ictyostelium mucoroides Bref., a member of the Acrasieae, was found three nes on the soil plates; once from a depth of 7 in. in an untreated plot, d twice from a depth of 4 in. in steamed soil.

Myxomycete plasmodia developed on soil plates in both 1949 and 1950. hey were recorded at depths of 1–7 in. from both untreated and formalineated plots, but not from the treated zone of the latter. Fruit-bodies ere not formed, and it is not known whether one or more forms were esent.

Nematodes, presumably free-living saprophytic forms, developed on out 1 in 25 of the soil plates prepared from untreated soil. They were corded at all seasons and from all levels in the upper layer of soil; ey were, however, most frequently isolated from a depth of 4–6 in. one steamed plot in 1949 nematodes were frequently recorded from e surface 1–4 in. of soil, 7–13 weeks after the treatment. It is interesting at the fungal flora did not return as rapidly in this plot as in the replicate. *throbotrys* E 129 was occasionally found attacking nematodes on soil ates, including some prepared from samples taken 9 in. below the rface.

FFECT OF STEAM STERILIZATION ON THE FUNGAL FLORA OF NURSERY SOIL

he effect of the Hoddesdon steam treatment was to destroy the fungi to depth of some 16 in. A profile sample taken immediately after steaming owed that fungi had been killed to a depth of 10 in. (Pl. 25, fig. 1). ost of the 'bottom' flora was still present. Samples collected 2 days after eaming showed that fungi had been killed to a depth of 14–16 in. ext-fig. 2 *B*), and samples collected 3 weeks later showed that the eated soil zone was still almost sterile with respect to fungi, though a few lonies occurred near the surface (Text-fig. 2 *C*). Samples collected and 10 weeks after treatment showed that a flora consisting mainly of ecies of *Mortierella* had returned near the surface of the soil. Plates from e 8 to 16 in. levels were still almost devoid of fungi (Text-fig. 2 *D*).

Later sampling has shown that this flora has gradually increased in numbers, but even 18 months after treatment numbers of species and of colonies were much less than in untreated soil (Text-fig. 2 *F*), even though a second crop of Sitka spruce was growing in the experimental plots. In all these samples, the number of species was greater near the surface of the soil than from the lower levels. Table 2 shows the commoner species of fungi which recolonized steamed plots. This table gives the percentage of plates from the treated zone on which a species occurred.

Fungal recolonization of steamed soil in the nursery was very slow, and even in the second year after treatment some small portions of the profile were still devoid of fungi. The flora at the end of the second year after steaming consisted mainly of *Mortierella* species, *Phoma eupyrena*, *Coniothyrium* E63 and *Cladosporium herbarum*, species which had originally recolonized the soil, with the addition of some species which had come in later such as the sterile cultures E64, E73 and *Phoma* E127. Only one species, *Aspergillus fischeri*, appeared to die out after an initial recolonization. Species of *Penicillium*, *Fusarium* and *Pythium* have gradually increased since the treatment but are still comparatively rare. Many of the common genera in untreated soil, *Absidia*, *Mucor*, *Acrostalagmus*, *Chaetomium* and *Volutella*, were rarely recorded from steamed soil. On the other hand several fungi which recolonized steamed soil were rare or were not recorded from untreated soil. The most notable was *Syncephalis* E69 which parasitized *Mortierella* species in the steamed plots. Whereas recolonizing species were usually more abundant near the soil surface, the sterile culture E73 was recorded predominantly from the 6 to 10 in. level.

Fungal recolonization of plots steamed in 1950 was substantially similar to that recorded in 1949. *Mortierella* species (including *M. vinacea*), *Phoma eupyrena*, *Coniothyrium* E63, *Cladosporium herbarum* and *Phoma* E127 were the dominant species. *Aspergillus fischeri* and sterile cultures E73 and E64 were not recorded. *Trichoderma viride*, *Fusarium oxysporum* and *Penicillium* species though not abundant, were commoner than in 1949.

The effect of the Canopy-steam treatment was to destroy the fungi to a depth of some 5–8 in. A normal fungal flora was still present below this depth. Fungal recolonization of Canopy-steamed plots was, however more rapid than that of Hoddesdon-steamed plots, and this recolonization was practically confined to the upper 3–5 in. of treated soil. Few fungi were recorded from the narrow zone between this level and the untreated layers of soil even 5 months after treatment. During that period there appeared little upward spread of fungi from the normal flora. The fungi which recolonized the treated zone were essentially the same as recolonized Hoddesdon-steamed soil, with the exception that *P. nigricans*, *P. spinulosum* and *P.* (*restrictum*?) were more abundant.

EFFECT OF FORMALIN TREATMENT ON THE FUNGAL FLORA OF NURSERY SOIL

The effect of formalin treatment was to destroy the fungi to a depth of some 5 in. Plates from soil samples collected 3 days after treatment showed that formalin had not penetrated very far into the soil, 1·5 and 4 in. respectively in the two plots. Soil plates from these treated regions were

Table 2. *Common fungi recolonizing steam-treated soil (percentage occurrence in profiles from duplicate plots)*

	Plot 6													Plot 2									
No. of weeks after treatment	0·3	3	7	10	13	17	21	30	34	58	63	72	83	0·3	3	7	10	13	17	21	30	34	63
Commonly occurring fungi:																							
*Penicillium E20	5	8	12	17	3	21	23	6	17	13	5	3	10	—	—	—	—	—	9	—	10	6	3
Mortierella E31	3	—	53	48	53	62	28	6	14	18	19	39	23	—	—	36	8	36	18	33	40	21	40
Fusarium oxysporum	3	—	2	6	3	—	—	—	—	—	5	10	10	—	—	—	—	—	—	—	—	—	30
Cladosporium herbarum	—	11	12	20	34	29	56	36	7	8	14	47	5	—	—	3	8	33	33	69	17	6	17
Phoma eupyrena	—	6	17	6	—	18	11	17	14	13	29	39	29	—	—	3	6	9	21	18	17	15	60
*Aspergillus fischeri	—	6	—	—	8	5	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mortierella alpina	—	3	—	40	11	31	17	36	24	65	17	18	39	—	—	17	22	21	27	24	7	—	36
Mortierella E32	—	—	24	31	6	—	20	36	5	18	40	16	18	—	6	22	14	15	6	3	26	9	30
Penicillium spinulosum	—	—	12	3	8	10	11	—	—	—	2	3	5	—	—	—	—	—	—	—	7	—	3
Trichoderma viride	—	—	12	45	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—
Pestalotia E61	—	—	10	—	—	—	—	—	2	8	—	3	—	3	—	—	3	—	—	—	7	3	3
Coniothyrium E63	—	—	—	8	17	23	34	20	41	18	34	36	52	—	—	3	3	—	15	84	20	66	83
E64 (sterile culture)	—	—	—	3	—	—	—	—	7	23	14	16	5	—	—	—	—	—	—	—	3	—	17
Humicola grisea	—	—	—	—	22	13	6	—	—	5	5	—	3	—	—	—	3	—	—	3	7	—	20
Pythium spp.	—	—	—	—	8	—	17	—	5	—	—	23	8	—	—	—	—	—	—	3	30	—	7
*Syncephalis E69	—	—	—	—	6	21	14	—	14	—	—	—	—	—	—	—	—	3	—	24	20	33	40
E71	—	—	—	—	6	—	—	11	2	—	—	13	—	—	—	—	—	3	—	6	3	—	—
Penicillium (restrictum?)	—	—	—	—	—	5	—	—	2	5	10	10	—	—	3	—	—	3	—	—	—	6	3
Penicillium nigricans	—	—	—	—	—	—	3	—	—	—	10	8	16	—	—	—	—	—	—	—	—	—	—
*Phoma E127	—	—	—	—	—	—	—	14	22	23	10	13	10	—	—	—	—	3	—	39	3	3	—
E73 (sterile culture)	—	—	—	—	—	—	—	20	34	23	22	16	5	—	—	—	—	15	—	6	—	—	—
Percentage of plates from steamed zone without fungi	90	78	40	6	20	10	6	11	5	3	14	3	10	93	89	56	58	24	36	6	0	9	0
Total no. of species from steamed zone	6	9	17	14	20	16	29	17	25	18	25	25	28	2	3	13	10	14	11	17	22	19	28
Total no. of species from untreated soil	57	53	50	57	51	49	60	54	57	54	54	56	57	57	53	50	57	51	49	60	54	57	54

* Rare or not recorded from untreated soil.

almost devoid of fungi, other depths had a normal flora (Text-fig. 3 *B*) Samples collected 3 weeks after treatment showed greater penetration o formalin, and even fewer fungi on soil plates from the treated zone (Text fig. 3 *C*). Table 3 records the common species of fungi which recolonize formalin-treated soil. This table gives the percentage of plates from th treated zone on which a species occurred. Fewer species were recorde than from steamed plots, and this simplification of the fungus flora wa apparent in samples collected throughout the first year. More specie were recorded in the second year, but it is possible that some soil mixin occurred during the replanting of the seed-beds. In contrast to steame plots the main fungal recolonizer of formalin-treated soil was *Trichoderm viride* which appears to have grown up and permeated the treated soi from below. Table 4 records the vertical distribution of *T. viride* in profile of formalin-treated soil, and shows that during the early stages of recolonization this fungus was rarely obtained from the surface soil layers.

In the 1950 plots formalin penetration was also some 5 in. There is however, evidence that in these plots, formalin initially penetrated th soil to a depth of 1–2 in. killing all soil fungi, and then penetrated t 4–6 in., but killing only some of the fungi in this lower layer (Pl. 25, fig. 3) Recolonization of formalin-treated soil was again dominated by *Trichoderma viride*. *Fusarium oxysporum* and *Phoma eupyrena* were also recorded fron formalin-treated soil.

EFFECT OF PARTIAL STERILIZATION TREATMENTS ON GROWTH OF SITKA SPRUCE SEEDLINGS

The effect of partial sterilization by steam or formalin on growth of Sitk spruce seedlings in old forest nursery soil is shown in Table 4 (assessment through the courtesy of the Forestry Commission).

In both series of plots, soil sterilization, either by steam or formali appreciably increased both total numbers and mean height of Sitka spruc seedlings. Both methods of sterilization also had some residual effects o numbers and mean height of seedlings grown in the second year afte treatment. Soil-steaming by the Hoddesdon grid gave more and talle seedlings than the other sterilization methods; the fact that plant growt was as good after formalin treatment as after Canopy steaming suggest that the superior results of Hoddesdon steaming may be due to greate depth of penetration rather than to any intrinsic superiority of steam ove formalin.

DISCUSSION

Partial sterilization treatment with steam or formalin markedly change the fungal flora of an old forest nursery soil. As reported by others fo similar treatments (Waksman & Starkey, 1923; Tam & Clark, 1943) fungi were initially destroyed or reduced to very low numbers. Funga recolonization was, however, very slow and even 18 months after treatmen treated soil yielded fewer species and colonies than untreated soil. Th penetration of different treatments varied considerably: steaming wit a Hoddesdon grid killed fungi to a depth of some 16 in; steaming wit a Canopy steamer killed fungi to a depth of some 8 in.; and formali

Table 3. *Common fungi recolonizing formalin-treated soil (percentage occurrence in profiles from duplicate plots)*

	Plot 3													Plot 4									
No. of weeks after treatment	0·3	3	7	10	13	17	21	30	34	58	63	72	83	0·3	3	7	10	13	17	21	30	34	63
Commonly occurring species:																							
Trichoderma viride	—	—	8	78	68	35	15	78	100	100	65	90	67	8	—	6	58	100	88	88	33	100	95
Phoma eupyrena	—	—	—	56	—	14	25	38	42	92	90	84	58	8	—	—	25	34	—	11	25	14	27
Cladosporium herbarum	—	—	—	—	16	21	65	16	—	16	5	21	8	—	—	6	—	—	4	5	8	—	5
Fusarium oxysporum	—	—	—	—	—	14	—	—	33	66	20	63	25	—	—	—	—	20	8	—	—	7	50
Penicillium spinulosum	—	—	—	—	—	7	—	—	8	8	5	—	8	—	—	—	—	—	—	22	—	7	—
P. nigricans	—	—	—	—	—	—	5	5	—	33	35	42	50	—	—	—	—	—	4	27	—	7	22
Mortierella alpina	—	—	—	—	—	—	5	5	—	—	20	14	33	—	—	—	—	—	—	—	—	—	—
Fusarium culmorum	—	—	—	—	—	—	5	—	—	42	10	7	16	—	—	—	—	—	—	—	—	—	5
Coniothyrium E63	—	—	—	—	—	—	—	16	—	84	50	70	83	—	—	—	—	—	—	—	25	—	38
Percentage of plates from treated zone without fungi	67	83	91	22	8	53	22	0	0	0	0	0	0	83	100	89	42	0	17	0	17	0	0
Total no. of species from treated zone	1	1	1	3	3	5	7	11	8	15	17	20	22	5	0	2	3	3	4	9	6	5	12
Total no. of species from untreated soil	57	53	50	57	51	49	60	54	57	54	54	56	57	57	53	50	57	51	49	60	54	57	54

Table 4. *Recolonization of formalin-treated soil from below by* Trichoderma viride

(Number of plates giving colonies of *T. viride* at different depths; maximum three plates for each depth: black figures indicate depth of formalin penetration.)

Depth in in.	Plot 3 (weeks after treatment)					Plot 4 (weeks after treatment)				
	0–3	3	7	10	13	0–3	3	7	10	13
1	**0**	0	0	3	0	0	0	0	0	3
2	2	0	0	1	2	0	0	0	1	3
3	3	0	1	**3**	3	0	0	0	3	3
4	3	**0**	0	3	**3**	**1**	0	0	**3**	3
5	3	3	**0**	3	3	3	**0**	1	3	**3**
6	3	2	3	2	3	3	3	**0**	3	3
7	2	0	3	3	2	3	3	3	3	3

treatment killed fungi to a depth of some 5 in. Below the depth of penetration of the treatment the fungal flora was normal.

After initial destruction of fungi by the Hoddesdon steam treatment there has been a gradual rebuilding of the fungal flora of the treated soil. The first fungi to return were species of *Mortierella* followed by *Cladosporium herbarum*, *Phoma eupyrena* and *Coniothyrium* E63, and later by sterile mycelia and *Phoma* E127. At the end of 18 months, a partial flora, consisting o about half the species present in untreated soil, had recolonized the treated soil. Relatively few of these, however, were abundant. Recolonization was not completely uniform and several species were locally abundant in some samples but absent from others. Few of the early colonizers appear as yet, to have been succeeded by other fungi, but rather there appears to have been a progressive rebuilding of the fungal flora, though several species recolonizing steam-treated soil were rarely recorded from untreated soil. Recolonization occurred first near the soil surface and later spread downwards. The last samples collected still showed more fungi near the surface than lower in the soil profile.

Table 5. *Effect of partial sterilization by steam or formalin on growth of Sitka spruce seedlings in old forest nursery soil*

	1949 plots				1950 plots	
	First year		Second year		First year	
Treatment	Total no. of seedlings per sq.yd.	Mean height (in.)	Total no. of seedlings per sq.yd.	Mean height (in.)	Total no. of seedlings per sq.yd.	Mean height (in.)
Steam: Hoddesdon	801	2·46	241	1·60	278	2·66
Steam: Canopy	—	—	—	—	206	2·07
Formalin	774	1·84	217	1·18	216	2·10
Untreated	373	1·03	60	0·97	182	1·09

The origin of the recolonizing flora is an interesting problem. Laboratory experiments have indicated that several of the species recorded from steamed soil may have survived the initial treatment. They include *Penicillium* E20, E71, *Aspergillus fischeri*, and several other Ascomycetes. Warcup (1951 *b*) has recorded many Ascomycetes as having spores resistant to a mild steam treatment. Few of these fungi, however, were commo members of the recolonizing flora. The results for both Canopy and Hoddesdon steam treatments, which showed that most recolonizing fungi were most abundant near the soil surface, suggest that fungi below the depth of penetration played little part in the recolonization of steam treated soil. Horizontal soil samples indicate that many recolonizing fungi came from untreated soil at the sides of the experimental plots though this recolonizing wave travelled mainly in the surface soil layers. Some recolonization may have been aerial. Agar plates exposed to aerial contamination, however, showed some species to be common in the air although rare in, or absent from, treated soil, and failed to show the presence of other fungi which became common in steamed soil. Neverthe less, the ecological selection from amongst air-borne potential colonist

ade by an agar plate would not necessarily be the same as that made by
eamed soil.

After the initial destruction of fungi in formalin-treated soil, recoloniza-
on was predominantly by *Trichoderma viride*, which appears to have
ecolonized the formalin-treated layer from below. An abundance of this
ngus makes it difficult to record other fungi on isolation plates; however,
study of plates after a short incubation period indicated that few other
ngi were present. Later recolonizers of formalin-treated soil included
homa eupyrena, *Coniothyrium* E63, and *Fusarium* species. Laboratory experi-
ents with a variety of soil types have shown that *Trichoderma viride* is often
e dominant fungal recolonizer after their treatment with formalin.
hese results are of interest in view of the suggested action of *T. viride* in
ontrolling root disease organisms (Weindling, 1932; Ludwig & Henry,
943; Rishbeth, 1950).

Partial sterilization of the old forest nursery soil appreciably increased
e growth of Sitka spruce seedlings, the effects lasting into the second
ear after treatment. Steam was also highly effective in controlling weeds,
ut formalin was much less effective as a weed killer.

This account forms part of an investigation on the effect of partial
erilization on the fungal flora of the soil, which is being continued with
e aid of a grant from the Agricultural Research Council. Facilities for
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EXPLANATION OF PLATE

Fig. 1. Duplicate series of soil plates prepared from forest nursery soil immediately after steam treatment (Hoddesdon). Fungi have been killed to a depth of 10 in.

Fig. 2. Duplicate series of soil plates prepared from untreated forest nursery soil.

Fig. 3. Duplicate series of soil plates prepared from forest nursery soil 1 month after formalin treatment. All fungi have been killed in the top 2 in., most have been killed in the 3–6 in layer, and below this there is a normal fungal flora.

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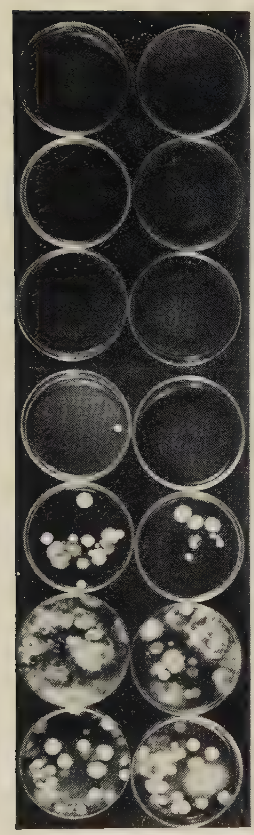

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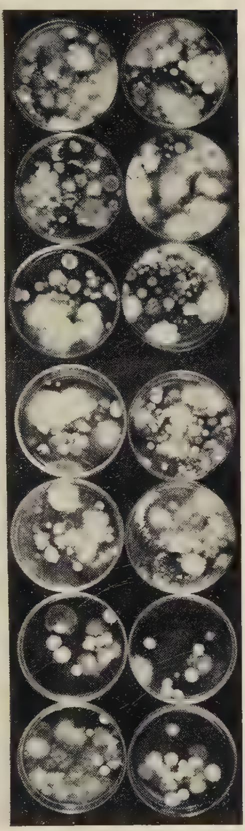

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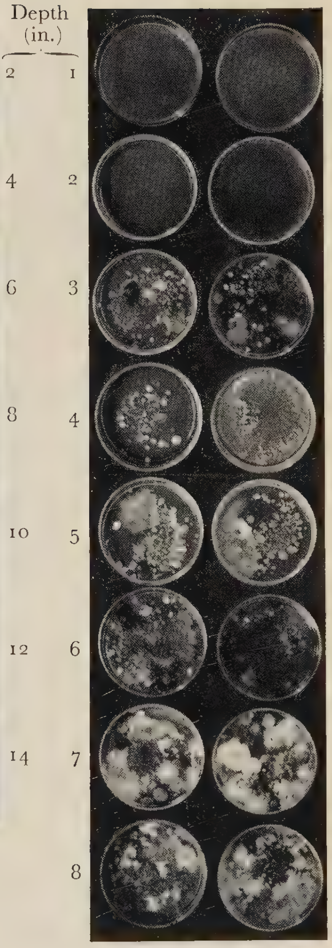

3

PHYSIOLOGIC SPECIALIZATION OF *PUCCINIA GRAMINIS* PERS. IN SOUTH-EAST SCOTLAND

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Inoculation experiments have shown that the following varieties of *Puccinia graminis* are present in south-east Scotland: *tritici, secalis, avenae, agrostidis, poae*, and probably *phlei-pratensis*. The natural and artificially inoculated hosts of each variety are given. A statistical examination is made of the measurements of the uredospores and teleutospores of each variety. The results agree fairly closely with a similar study made in America. The physiologic races of *P. gr. avenae* present have been identified.

The existence of well-defined strains within a morphological species of rust was first demonstrated for *Puccinia graminis* by Eriksson and Henning (Eriksson, 1894; Eriksson & Henning, 1894). They showed that there were several strains, which they called *formae speciales*, but which are now usually termed varieties (Brooks, 1944), and *P. graminis* was divided into six varieties:

P. gr. tritici	On wheat
P. gr. avenae	On oats and certain grasses
P. gr. secalis	On rye and certain grasses
P. gr. agrostidis	On *Agrostis* spp.
P. gr. poae	On *Poa* spp.
P. gr. airae	On *Aira caespitosa*

P. gr. epigaei on *Calamagrostis* spp. was added later (Eriksson, 1930).

At Cambridge, Mehta (1923) found two varieties, *tritici* and *secalis*. In Scotland, Maxwell and Wallace (1926) identified five varieties: *tritici, secalis, avenae, phlei-pratensis* and *agrostidis*.

VARIETIES IDENTIFIED 1947–49 IN SOUTH-EAST SCOTLAND

The host range of black rust in south-east Scotland has been dealt with elsewhere (Batts, 1951). Only slight infection was found on some grasses, and it was not always possible to identify the variety of black rust. For most hosts, however, infection experiments have indicated which variety was present.

The following varieties were identified:

P. gr. tritici Erikss. & Henn.
P. gr. secalis Erikss. & Henn.
P. gr. avenae Erikss. & Henn.
P. gr. agrostidis Erikss.
P. gr. poae Erikss. & Henn.

The rust was found once on *Phleum pratense* and inoculation of young barberry leaves in the greenhouse gave positive results. It is highly probable that the variety *phlei-pratensis* Erikss. & Henn. was present, bu as no more material became available no definite conclusion could b reached.

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The natural hosts and results of inoculation experiments with eac variety were as follows:

Puccinia graminis tritici

Naturally and artificially infected	*Triticum vulgare*
Weakly infected by artificial inoculation	*Hordeum vulgare*, *Secale cereale*
Inoculated but not infected	*Agropyrum repens*, *Agrostis* sp., *Anthoxanthum odoratum*, *Avena sativa*

Stakman and Piemeisel (1917) stated that rye and some species o *Agropyrum* (other than *repens*) were natural hosts, and that *A. repens* and oat could be weakly infected with the *tritici* variety. Mehta (1923) was unabl to infect rye, but did infect barley. In France, Guyot, Massenot an Saccas (1946) found that barley and two strains of rye were susceptible t the wheat variety.

Puccinia graminis secalis

Naturally and artificially infected	*Agropyrum repens*, *Bromus sterilis*, *Hordeum vulgare*, *Secale cereale*
Inoculated but not infected	*Agrostis* sp., *Anthoxanthum odoratum*, *Avena sativa*, *Lolium italicum*, *L. perenne*, *Triticum vulgare*

Stakman and Piemeisel (1917) also found barley, rye and couch grass t be natural hosts of *P. gr. secalis*. They weakly infected wheat, while Meht (1923) infected one variety only, Red Sudan. The French workers con sidered the rust on rye and couch to belong to the same variety, bu separated the rust on *Hordeum*. They found that wheat was susceptible t the *Hordeum* and rye and couch varieties.

Puccinia graminis avenae

Naturally and artificially infected	*Alopecurus pratensis*, *Arrhenatherum avenaceum*, *Avena fatua*, *A. sativa*, *Dactylis glomerata*, *Trisetum flavescens*
Easily infected artificially	*Poa pratensis* (one test only)
Inoculated but not infected	*Agropyrum repens*, *Anthoxanthum odoratum*, *Holcus lanatus*, *Hordeum vulgare*, *Lolium italicum*, *L. perenne*, *Phleum pratense*, *Secale cereale*, *Triticum vulgare*

Economically, this variety is of most importance, and as far as host rang is concerned, the most widespread. Stakman and Piemeisel (1917) foun the variety occurring naturally on oats, wild oat and cocksfoot, and easily infected meadow foxtail and Yorkshire fog. Guyot *et. al.* (1946) easily infected oats, tall oat grass, cocksfoot, golden oat grass, and sheep's fescue.

Festuca rubra (red fescue) has been found naturally infected in association with grasses known to be carrying the *avenae* variety, and it is possible that ed fescue carries the same variety.

Puccinia graminis agrostidis

Naturally and artificially infected	*Agrostis alba*, *A. vulgaris*
Inoculated but not infected	*Avena sativa*, *Hordeum vulgare*, *Secale cereale*, *Triticum vulgare*

This variety is apparently restricted to species of *Agrostis*.

Puccinia graminis poae

Naturally and artificially infected	*Poa pratensis*, *P. trivialis*
Easily infected artificially	*Poa annua*
Inoculated but not infected	*Avena sativa*, *Hordeum vulgare*, *Secale cereale*, *Triticum vulgare*

In south-east Scotland, species of *Poa* always appear to carry the *poae* variety, but there are at least two records of *P. gr. avenae* being isolated from *Poa* species (Stakman, 1914; Fischer & Claassen, 1944), and in one test I successfully inoculated *Poa pratensis* with *P. gr. avenae*.

References to black rust on sweet vernal grass are rare. Guyot *et al.* (1946) reported that isolations from the grass would not infect the cultivated cereals. Fischer and Levine (1941) indicated that it carries the *avenae* variety, and Verwoerd (1935) claimed this also for a closely related species, *Anthoxanthum aristatum*. In Australia, Waterhouse (1929) was unable to infect wheat or oats with uredospores from sweet vernal grass.

STATISTICAL STUDY OF THE VARIETIES

Levine (1923) was the first to apply a statistical study to the varieties *tritici*, *secalis*, *avenae*, *phlei-pratensis* and *agrostidis*. A year later, Stakman and Levine (1924) added the variety *poae* and compared the six varieties.

I took uredo- and teleutospores of the varieties *tritici*, *secalis*, *avenae*, *agrostidis* and *poae* from wheat, couch grass, oats, *Agrostis vulgaris* and *Poa trivialis* respectively. All the spores were measured with the same micro-cope, fitted with a mechanical stage, which was so moved that no spore was measured twice. Freshly collected uredospores were always used, mature spores only being dusted on to the slide. Teleutospores were taken rom material stored for about 6 weeks. The spores were mounted in tap water and a hundred uredospores and two hundred teleutospores of each variety were measured. Table 1 gives my measurements of the varieties, nd Stakman and Levine's measurements are given in Table 2 for omparison.

Uredospores

The spore lengths of the five varieties are significantly different from one another, a feature reported also by the American workers. The difference in width of the *tritici* and *avenae* varieties is not significant. Nor is that of the *agrostidis* and *poae* varieties, though the widths of these two varieties are significantly different from the widths of the varieties *tritici*, *avenae* and *secalis*. The *secalis* variety has significantly narrower spores than the *tritic* and *avenae* varieties. These results agree with those of Stakman and Levine.

Table 1. *Measurements of varieties collected in south-east Scotland*

	Uredospores				Teleutospores			
Variety	Length (in μ)	Standard error	Width (in μ)	Standard error	Length (in μ)	Standard error	Width (in μ)	Standard error
P. gr. tritici	30·52	± 0·34	18·12	± 0·19	48·79	± 0·35	17·84	± 0·12
P. gr. secalis	26·23	± 0·23	17·01	± 0·14	48·19	± 0·39	17·87	± 0·11
P. gr. avenae	28·69	± 0·35	17·72	± 0·24	47·27	± 0·36	17·62	± 0·13
P. gr. agrostidis	24·76	± 0·30	14·18	± 0·19	39·28	± 0·32	16·81	± 0·13
P. gr. poae	20·85	± 0·30	14·17	± 0·17	35·46	± 0·36	16·94	± 0·12

The mean figure is given in each case

Table 2. *Measurements of varieties collected in the United States*

(After Levine, 1923, Stakman & Levine, 1924.)

	Uredospores				Teleutospores			
Variety	Length (in μ)	Standard error	Width (in μ)	Standard error	Length (in μ)	Standard error	Width (in μ)	Standard error
P. gr. tritici	32·40	± 0·19	19·79	± 0·06	51·80	± 0·49	16·67	± 0·12
P. gr. secalis	27·14	± 0·14	17·19	± 0·06	47·35	± 0·45	14·77	± 0·12
P. gr. avenae	28·50	± 0·15	19·94	± 0·07	46·15	± 0·43	15·84	± 0·12
P. gr. agrostidis	22·37	± 0·12	15·68	± 0·05	40·30	± 0·40	14·64	± 0·12
P. gr. poae	18·64	± 0·10	15·78	± 0·07	36·90	± 0·62	15·52	± 0·14

Teleutospores

In contrast with the close similarity of both sets of uredospore measurements, the teleutospore measurements are rather more variable, and fo this reason two hundred spores were measured. There is, for example, onl 1·52 μ difference in the lengths of the *tritici* and *avenae* varieties fron Scotland, whereas there is 5·65 μ difference between the lengths of th same varieties in America. Several other such length differences may b seen in Tables 1 and 2. The sets of width measurements are not strictl comparable, as Stakman and Levine measured the spores at the septum whereas I measured the spores at the widest point, usually about th middle of the upper cell.

In Scotland, the teleutospores of the *tritici* variety are significantl longer than those of the *avenae*, *agrostidis* and *poae* varieties. The lengths o the *tritici* and *secalis* varieties do not differ significantly and neither d those of the *secalis* and *avenae* varieties. There are, however, significan differences between the *avenae* and *agrostidis* varieties, and the *agrostidis* an *poae* varieties. The American results agree except that the *tritici* variety ha significantly longer spores than the *secalis* variety.

The widths of the five varieties from Scottish collections do not var much. The *tritici*, *secalis* and *avenae* varieties are significantly wider tha ıe *agrostidis* and *poae* varieties, but otherwise there are no significant ifferences.

PHYSIOLOGIC RACES OF *PUCCINIA GRAMINIS AVENAE* ERIKSS. & HENN.

hirteen physiologic races of the *avenae* variety are now known and possible fourteenth has been described (Fischer & Claassen, 1944). The ırly work on identification of the races was performed using the oat ırieties White Tartar, Richland and Joanette Strain as the differentials: ore recently the name White Russian has been given to White Tartar, ıd a re-selection of Joanette Strain called Sevnothree is now used.

Stakman, Levine and Bailey (1923) described the first four races of the ıst and inferred the existence of a fifth, which Bailey (1925) later escribed. Gordon and Bailey (1928) added race 6 and Waterhouse (1929) olated two new races from Australia, race 7 (originally numbered 6) ıd race 8 (originally numbered 7), both of which were also found in anada about the same time, as was also race 9. Race 10 was discovered 1930 (Cotter, 1932) and race 11 was found in Germany seven years later Hassebrauk, 1938). Race 12, first seen in 1938, was described with ıce 13 in 1944 (Newton & Johnson, 1944). A collection of the rust on *oa ampla* Morr. was regarded by Newton and Johnson as a possible urteenth race, but there is some doubt about its authenticity, for all but ıe of seventeen varieties of oats inoculated proved immune: it may ıerefore be a race of *Puccinia graminis poae*.

IDENTIFICATION OF RACES IN SOUTH-EAST SCOTLAND

eed of the three differential hosts was kindly supplied by Dr T. Johnson. redospores of *P. gr. avenae* were collected whenever possible and seedlings the differentials were inoculated in the usual manner. For the identification of races, the table of infection types given by Newton and Johnson 944) was used.

Fifteen isolations made from oats (fourteen collected in the Borders, one Angus) and two isolates from *Dactylis glomerata* gave in each case a mean action of 2+, 1− and 1+ on White Tartar, Richland, and Sevnothree spectively. This is characteristic of race 1. Uredospores on *Alopecurus atensis* from two Border localities gave on these varieties a mean reaction 2, 1 and 3−, which indicates race 2. It is surprising that with the large umber of barberries present, offering endless scope for hybridization, ıce 1 is the only race identified on oats and cocksfoot, and race 2 is pparently present on meadow foxtail.

The work was carried out under the supervision of Dr Malcolm Wilson, hose interest and advice I wish to acknowledge.

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VIABILITY OF SPORES OF SOME COPROPHILOUS SPECIES OF *SORDARIA* AND *CHAETOMIUM*

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In 1939, at the outbreak of war, a number of Petri dish cultures had to be eft on a shelf in the Botany Research Laboratory of Birkbeck College. They were protected by the shelf above, and later wire netting was placed n front so that they would not be shaken off. During the war the cultures suffered great extremes of humidity and temperature. The floor above was burnt out, the room was flooded and the ceiling collapsed. Later the adjoining building was burnt out and the wall to which the shelves were fixed became very hot. During the fly-bomb and rocket periods the building was again severely damaged.

In 1945–6 attempts were made to germinate spores from the cultures with some success. The room was then found to be unsafe so the cultures were removed and again left, until the autumn of 1948 when the work was continued. Germination of the spores of each species was verified microscopically and several generations of the resulting fungi were grown.

The spores of the following species were germinated in 1945–6, and again in 1948 from cultures 10 years old: *Sordaria fimicola* Rob., *S. macrospora* Auersw., *S. bombardiodes*, *Chaetomium globosum* Knz., *C. murorum* Corda, *C. carprinum* Banier, *C. bostrychodes* Zopf, *C. cochliodes* Pall., and saltants of *C. cochliodes* nos. 4, 7A and 33 (Dickson, 1932).

Spores of *Podospora minuta* Fuckel and *Philocopra setosa* Wint. were germinated in 1945–6 but not in 1948, probably because of death of the cultures. Spores of saltant SS8 of *Chaetomium cochliodes* could not be germinated, but those of a 4-year-old culture of this saltant, which had been kept by Dr Irene Wilson, were successfully germinated.

On the same shelf there were also cultures of *Philocopra pleiospora* Wint., *P. curvicalla* Wint., *Sporormia intermedia* Auersw., *S. bipartis* Cane., and two unnamed species of *Sporomia*. It was not found possible to germinate spores rom these cultures. The cultures of the *Philocopra* spp. had very few perithecia and most of the spores had been ejected. The perithecia of all he species of *Sporomia* are small and almost completely embedded in the ubstratum and were more difficult to manipulate. These facts may account for their failure to germinate, or the spores may have lost their viability.

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NOTES ON SOME MARINE FUNGI

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A survey has been made of marine fungi occurring on seaweeds, wood and rope in the intertidal area and below low-water mark at Aberystwyth and at various other places along the coast of Cardigan Bay, at Dale in Pembrokeshire and at Newcastle, Co. Down, Northern Ireland. Twenty species from the Pyrenomycetes and Fungi Imperfecti are mentioned, together with brief notes on their occurrence. Of these, the seventeen listed have been identified as previously described species and three (which will be described later) are probably new. The following are new records for Britain: *Halophiobolus salinus*, *H. opacus*, *Ceriosporopsis halima*, *Peritrichospora integra*, *Remispora maritima*, *Amphisphaeria maritima*, *Helicoma maritimum*, *H. salinum*, *Speira pelagica* and *Botryophialophora marina*.

Since records of marine fungi are comparatively rare, the following list of species which contains ten new records for Britain may be of interest. Three new species have also been found which will be described in a later publication. All the species mentioned were collected from the west coast of Wales between Borth on Cardigan Bay and the Dale peninsula at the mouth of Milford Haven in Pembrokeshire, or from Newcastle in Northern Ireland. The scope of the present list is limited to intertidal and sublittoral fungi on seaweeds, rope or wood, and includes only Ascomycetes and Fungi Imperfecti. Notes on previous records of the fungi are given.

PYRENOMYCETES ON SEAWEEDS

(1) *Mycosphaerella Pelvetiae* Sutherland

This species was described by Sutherland (1915). It is a systemic endophyte in *Pelvetia canaliculata* Dcne. & Thur., forming perithecia on the receptacles of the alga. It has been seen on all plants of *P. canaliculata* examined in Wales and Northern Ireland. Sutherland states that it does not occur on *P. canaliculata* var. *libera* Oliver at Blakeney.

(2) *Mycosphaerella Ascophylli* Cotton

Church (1893) drew attention to this Pyrenomycete on *Ascophyllum nodosum* Le Jol., and it was subsequently named by Cotton (1908). David (1943) and Lloyd (1947) have referred briefly to this species. It is a systemic endophyte in *A. nodosum*, forming perithecia on the receptacles and has been seen on all plants investigated in Wales and Northern Ireland. Salt marsh varieties of *A. nodosum* have not been examined.

(3) *Orcadia Ascophylli* Sutherland

This species was originally described by Sutherland (1914) from the Orkney Islands. It is fairly common at Aberystwyth where it is parasitic on old worn thalli of *Ascophyllum nodosum* growing near the upper limit of the Ascophyllum zone.

4) *Trailia Ascophylli* Sutherland

This is another species described by Sutherland (1914) which is parasitic on *Ascophyllum nodosum* in the Orkneys and on floating masses of the eaweed in the North Sea. In Aberystwyth it has been found only in close ssociation with *Orcadia Ascophylli*, but it is not so common as that species.

5) *Halophiobolus salinus* Linder

This fungus is a common saprophyte on the eastern seaboard of the Jnited States of America, where it has been recorded by Barghoorn and inder (1944) on submerged wood and on rope from the intertidal zone. Only one collection of this species has been made in Aberystwyth and this s the only record, so far, from Britain. Here the habitat is different from he American material, the fungus being found on very old worn stumps of a seaweed, probably *Fucus vesiculosus*, still attached to rocks in the ntertidal region. Wood and rope in the same locality have been searched n vain for this fungus.

6) *Leptosphaeria Chondri* (Rostr.) Rosenv. (= *Didymosphaeria marina* (Rostr.) ind)

Blackening of the cystocarpic and tetrasporic pustules of *Chondrus crispus* yngb. is a frequent indication of the presence of this parasite. It was first ecorded by Rostrup (1889), and there have been many subsequent eferences to its occurrence (Berlese, 1890; Jones, 1898; Rosenvinge, 1906; Cotton, 1908; Lind, 1913). It appears to be widely distributed, being ecorded from Denmark, from several localities round the British Isles nd from the Massachusetts coast. I have also seen it on *Chondrus crispus* rom France. My attention was first drawn to this species in the berystwyth district by Dr E. A. Lewis. Some work on this fungus has een carried out recently by Lloyd (1947) and the life history and biology as been studied by Knoyle (not yet published).

7) *Hypoderma Laminariae* Sutherland

Sutherland (1914) described this species which is parasitic on *Laminaria accharina* Lamour in Orkney. It has been sought in vain at various points long the west coast of Wales from Borth on Cardigan Bay to Dale in Pembrokeshire, but it occurs in quantity washed up on the shore after torms at Newcastle, in Northern Ireland.

FUNGUS IMPERFECTUS ON SEAWEEDS

8) *Cercospora salina* Sutherland

Sutherland (1916) has recorded this species as a very common saprophyte on various decaying seaweeds picked up from rock pool or beach long the coast of Aberdeen, Ayrshire, Dorset and Orkney. It is also ommon on decaying seaweeds in the intertidal region along the Welsh oast.

PYRENOMYCETES ON WOOD OR ROPE

The following five species were described for the first time by Barghoorn and Linder (1944) from various localities on the coast of Massachusetts, Maine and Connecticut, U.S.A. They are recorded here for the first time for Britain.

(9) *Halophiobolus opacus* Linder

This is the commonest species of marine Pyrenomycete occurring on wood and rope in the Aberystwyth area. It has rarely failed to appear within a few months on any fresh wood or rope left in the sea near or below low-water mark. It is the first fungus to establish itself on these materials.

(10) *Ceriosporopsis halima* Linder; (11) *Peritrichospora integra* Linder; (12) *Remispora maritima* Linder

These three species have been found on freshly cut wood blocks submerged near or below low-water mark for about a year. Sometimes *Halophiobolus opacus* is still flourishing also. *Remispora maritima* has always been found to be associated with a very light and rotten condition of the wood. *R. maritima* and *Ceriosporopsis halima* have also been found on drift wood. All three species occur in the Aberystwyth district, and *C. halima* has also been found near Dale in Pembrokeshire.

(13) *Amphisphaeria maritima* Linder

Pieces of wood washed up and wedged in the mid-tidal region frequently bear the perithecia of *Amphisphaeria maritima*. Several collections have been made at Dale, but the fungus is less frequent at Aberystwyth.

FUNGI IMPERFECTI ON ROPE OR WOOD

The following species described by Barghoorn and Linder (1944) are new records for Britain.

(14) *Helicoma maritimum* Linder

This is a common marine species occurring on rope and on wood in the intertidal zone, especially near low-water mark.

(15) *Helicoma salinum* Linder

Barghoorn and Linder (1944) state that *Helicoma salinum* is the imperfect stage of *Ceriosporopsis halima*. It has only been collected once at Aberystwyth on rope washed up on the shore. It was associated with *Halophiobolus opacus* and with an unidentified member of the Fungi Imperfecti with 4-armed conidia.

(16) *Speira* (*Cattania*) *pelagica* Linder

Several collections of wood washed up and partly embedded in sand in the intertidal zone near Dale in Pembrokeshire bore the dark brown conidia of this species, sometimes associated with *Helicoma maritimum* and an unidentified Pyrenomycete.

(17) *Botryophialophora marina* Linder

Scrapings from a block of wood attached near mean low-water mark of neap tides for 7 months yielded this species in culture. It was associated on the wood with a very attractive Hyphomycete with tri-radiate, septate conidia, probably a species of Trinacrium.

I am very grateful to Dr W. Lawrence White, Director of the Farlow Herbarium and Library, Cambridge, Massachusetts, who kindly lent me herbarium specimens which enabled me to check all those species except *Botryophialophora marina* mentioned in this paper, which were originally described by Barghoorn and Linder in 1944. I also wish to thank Dr G. K. Sutherland for kindly examining a culture of *Cercospora salina*.

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(*Accepted for publication* 6 *March* 1951)

ANNELLOPHORA NOM.NOV. (≡*CHAETOTRICHUM* SYD. NON RABENH.)

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(With 3 Text-figures)

Because *Chaetotrichum* Sydow is a later homonym of *Chaetotrichum* Rabenhorst the name *Annellophora* is proposed to replace it. Three species are included in the emended genus; *Chaetotrichum solani* Syd. from Costa Rica continues as type species of the new name and this is illustrated and redescribed from the type collection. Two new species from West Africa, *Annellophora africana* on *Anthocleista nobilis* leaves and *Annellophora appendiculata* on a blue green alga on *Culcasia scandens* are illustrated and described. *Chaetotrichum macrosporum*, the only other species described in the genus *Chaetotrichum* Syd., is considered to be based on two fungi, and is similar in this respect to *Helminthosporium dendroideum* Berk. & Br.

In 1927 Sydow published his generic name *Chaetotrichum* for a single species *C. solani* with the following diagnosis; 'Biophilum. Hyphae repentes, tenues, pallide coloratae usque fuscidulae, tenuiter ramosae setas vel hyphas steriles simplices erectas fuscas emittentes. Conidia solitarie in apice ramulorum hypharum repentium rarius in setulis orta, elongata, helminthosporioidea, phaeophragmia.'

The generic name *Chaetotrichum* had already been published, albeit unnecessarily, by Rabenhorst in 1844 as a nom.nov. for *Chaetosporium* Corda (1837) which was based on *C. graminis* Corda and for which Rabenhorst published the new combination *Chaetotrichum graminis*. In a footnote Rabenhorst added 'Das wir den Namen *Chaetosporium* in *Chaetotrichum* verwandelt haben, wird uns hoffentlich Herr Corda verzeihen, da hier von Sporen gar keine Rede sein kann'. Saccardo (1886, p. 761) listed *Chaetosporium* Corda with 'Genera dubia vel excludenda'. Sydow's generic name is a later homonym and requires a new name for his single species which is considered generically distinct from anything hitherto published as a type species that is known to me. The new generic name *Annellophora* is proposed, and because Sydow misinterpreted his *Chaetotrichum solani* the generic diagnosis is emended not only to include the type but also two other species.

Annellophora Hughes nom.nov.

≡*Chaetotrichum* Sydow, in *Ann. mycol., Berl.*, **25**, 150, 1927; non Rabenhorst in *Deutschlands Kryptogamen-Flora*, 1 (Pilze), p. 68, 1844.

Type species: **Annellophora solani** (Sydow) Hughes comb.nov. ≡*Chaetotrichum solani* Sydow in loc. cit.

Emended generic diagnosis

Fungi imperfecti, hyphomycetes, dry phragmosporae.

Mycelium superficial, foliicolous, solitary or in association with Cyanohyceae, Asterineae or Meliolineae, composed of hyaline to brown septate, ranched hyphae.

Conidiophores simple, straight or curved, more or less cylindrical, septate, rown below, paler above, elongating by numerous successive cylindrical roliferations through the successive conidial scars, finally giving the upper art of the conidiophore an annellate appearance. They arise directly rom a repent hypha as a lateral branch.

Conidia obclavate to fusiform, 3- to 7-septate, pale brown to brown, paler t the apex, with or without a single basal and lateral cellular appendage. hey arise singly and solitarily as blown-out ends of the apex of the onidiophore and its successive proliferations.

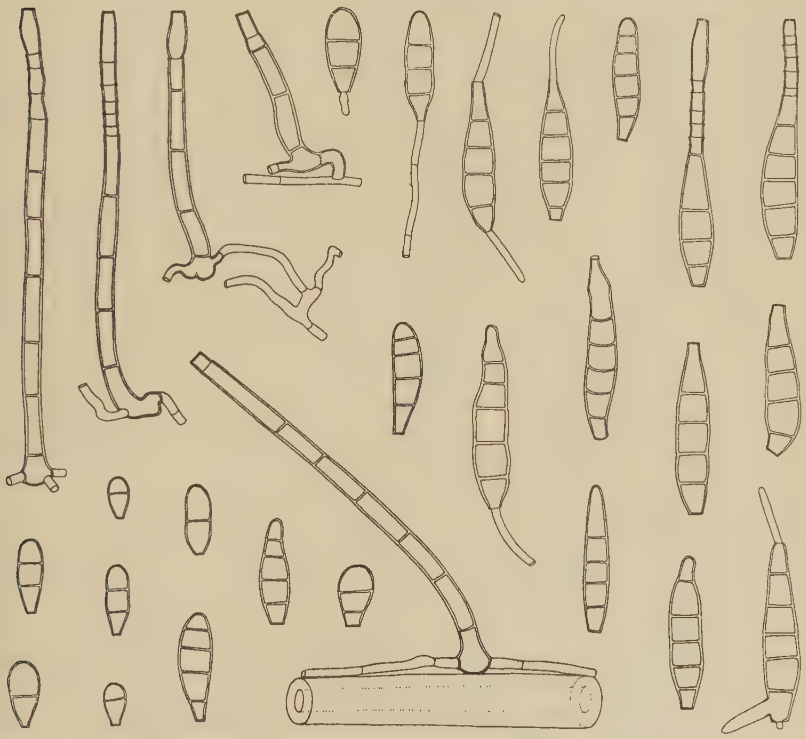

Fig. 1. *Annellophora solani.* Mycelium, conidiophores and conidia from the type collection [Herb. I.M.I. 8654.]; × 500.

(1) **Annellophora solani** (Sydow) Hughes

The type collection of Sydow's fungus was issued by him in *Fungi xotici exsiccati* 715 'in foliis *Solani erythrotrichi*, saepe in consortio *Asterinae agantis* Speg. et *Appendiculellae adelphicae* Syd. [≡ *Irene adelphica* (Syd.) tevens in *Ann. mycol., Berl.*, **25**, 428, 1927]'. One of the copies of this xsiccatum is Herb. I.M.I. 8654; this is illustrated in Fig. 1 and redescribed elow.

Description of Herb. I.M.I. 8654

Annellophora solani forms brownish hypophyllous colonies up to 1 cm. in diameter without causing any discoloration of the leaf.

The *mycelium* is composed of superficial, branched, hyaline to brown, septate, smooth-walled, anastomosing hyphae 1·8–4 μ wide on the surface of the leaf and running over the arms of the stellate leaf hairs.

The *conidiophores* arise singly or in groups of 2–4; they are simple, straight or curved, with a basal intercalary foot cell, up to 9 μ wide, and then more or less cylindrical and 4–6 μ wide, septate, thick-walled, dark brown but paler at the apex, 25–155 μ long, and they arise apparently in no regular order on the hyphae. Towards the apex they bear up to six transverse circular ridges [Sydow figured six and seven] at regular or irregular intervals, and these represent the scars of former attachment of conidia through which the conidiophore has continued growth.

The *conidia* arise by the blowing out of the apex of the conidiophore or its proliferations. A basal septum is laid down, the initial increases in length and becomes 3- to 6-septate; the mature conidium appears to fall away readily. Proliferation through the old scar by the conidiophore finally results in a terminal conidium terminating the growth of the conidiophore until the conidium has matured and fallen, and another proliferation commenced. The mature conidia are straight, 30–50 μ long, 8–10 μ wide, oval, fusiform or almost obclavate, 3- to 6-septate, very slightly or not at all constricted at the septa, smooth, thick-walled, pale brown to dark brown but paler than the conidiophores, with a 3·5–4·5 μ wide, flat basal scar. The conidia appear to have germinated readily at the base and apex, whilst still on the host to produce a tangle of long, branched, septate, subhyaline hyphae. Occasionally the apex has elongated, and the proliferation has functioned as a conidiophore, and evidence of the former attachment of up to seven conidia is shown by the presence of seven scars along its length. The conidia produced by these secondary conidiophores are generally shorter, paler, fewer-septate, narrower, and possess a narrower scar than those conidia produced on normal conidiophores.

This fungus appears to have been somewhat misunderstood by Sydow. The conidiophores described here were called sterile hyphae, although they were stated to be capable of bearing conidia. The significance of the rings along the upper part of the true conidiophores was not realized. Sydow, furthermore, regarded the germination hyphae of the conidia as mycelial hyphae bearing conidia.

(2) **Annellophora africana** sp.nov.

Coloniae atrae, hypophyllae, effusae.

Mycelium superficiale ex hyphis subhyalinis vel brunneis, septatis, ramosis, 1–3·5 μ crassis compositum.

Conidiophora simplicia, recta vel curvata, septata, crasso-tunicata, plus minusve cylindracea, basi atrobrunnea 4·5–6 μ, apice pallidiora 3·5–4·5 μ crassa, 250–500 μ longa, per usque ad 18 proliferationes successivas cylindraceas elongascentia.

Conidia singula primo in apice conidiophori et dein successivarum proliferationum oriunda, plus minusve obclavata, recta vel leniter curvata, 4–7-septata, laevia, brunnea, 30–70 × 5–7 μ, interdum apice per usque ad 17 proliferationes successivas elongascentia;

onidiis secundariis parvioribus pallidioribus in apice proliferationum successivarum riundis.

Habitat in foliis vivis *Anthocleistae nobilis* (Loganiaceae), Gold Coast Colony, Abe, 5 v. 1949, Herb. I.M.I. 39909 (typus).

Annellophora africana forms black hypophyllous effuse colonies which can over the whole leaf surface without causing discoloration of the leaf.

The *mycelium* is composed of superficial, branched, subhyaline to brown, eptate, smooth-walled hyphae 1–3·5 μ wide.

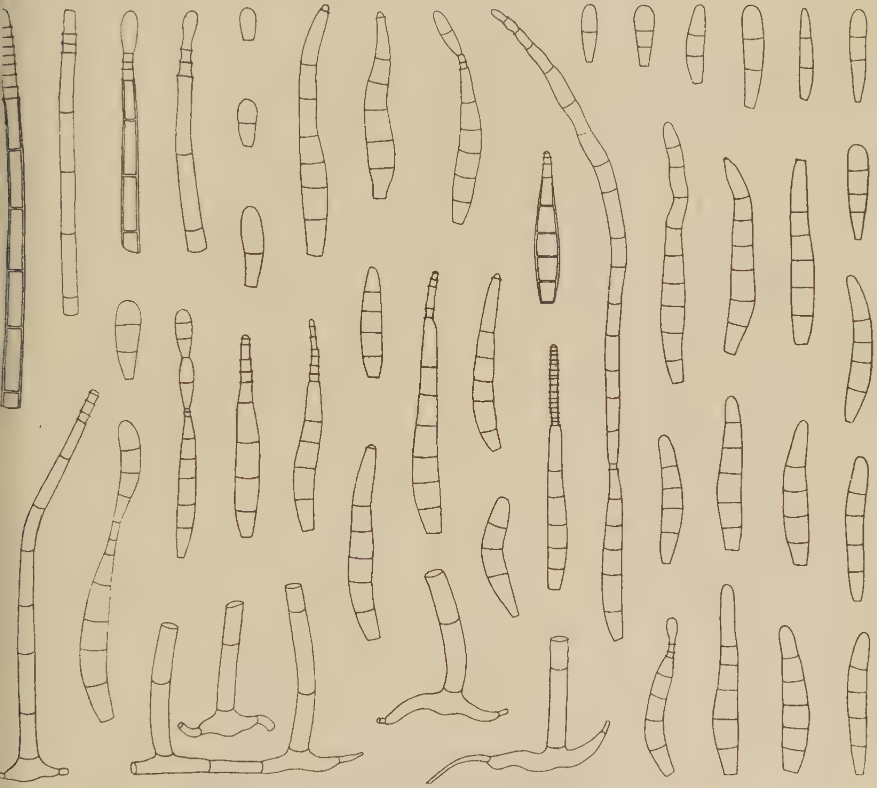

Fig. 2. *Annellophora africana.* Mycelium, conidiophores and conidia from the type collection [Herb. I.M.I. 39909]; × 500.

The *conidiophores* arise singly, are straight or curved, simple, with an ntercalary foot cell formed by the irregular swelling of a hyphal cell; ney are septate, thick-walled, more or less cylindrical and 4·5–6 μ wide nd dark brown at the base, tapering to a paler apex 3·5–4·5 μ wide; ney are 250–500 μ long. Towards the apex they bear a continuous or iscontinuous series of up to eighteen transverse darker coloured circular dges, and these represent the scars of former attachment of conidia nrough which the conidiophore has continued growth.

The *conidia* arise by the blowing out of the apex of the conidiophore or its roliferations; a basal septum is laid down, the initial increases in length nd becomes 4- to 7-septate; the mature conidium appears to fall away readily. Proliferation through the old scar by the conidiophore finally results in a terminal conidium terminating the growth of the conidiophore until the conidium has matured and fallen and another proliferation commenced. Up to eighteen conidia can be produced by a single conidiophore by means of successive proliferation. Mature conidia are straight or slightly curved, 30–70 μ long, 5–7 μ wide, narrowly obclavate, 4- to 7-septate, not constricted at the septa, smooth, brown, but paler than the conidiophores with a 3·5–4·5 μ wide flat basal scar. Whilst still on the host they can produce an apical proliferation which functions as a conidiophore, and evidence of the former attachment of up to seventeen conidia is shown by the presence of seventeen scars along it. Such proliferated conidia may reach a length of 85 μ. The conidia produced by these secondary conidiophores are generally shorter, paler, fewer-septate, narrower and possess a smaller scar than those produced on normal conidiophores.

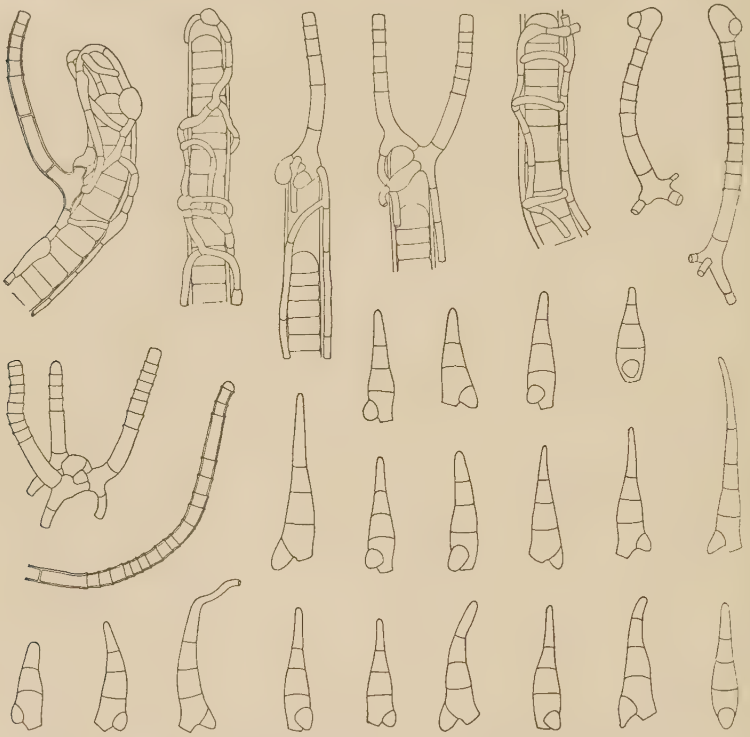

Fig. 3. *Annellophora appendiculata*. Mycelium, conidiophores and conidia from the type collection [Herb. I.M.I. 43696]; × 500.

(3) **Annellophora appendiculata** sp.nov.

Coloniae epiphyllae, atrobrunneae, usque ad 1 cm. diam.

Mycelium in filamentis Scytonematacearum parasitans, tenue, ex hyphis subhyalinis vel pallide-brunneis, septatis, ramosis, anastomosantibus 2–9 (plerumque 2–3·5) μ crassis compositum.

Conidiophora simplicia, recta vel curvata, usque ad 3-septata, crasso-tunicata, plus inusve cylindracea, 3·5–5 μ crassa, brunnea, apice pallidiora, 14–90 μ longa, per usque d 18 proliferationes successivas cylindraceas elongascentia.

Conidia singula primo in apice conidiophori et dein successivarum proliferationum riunda, obclavata, recta vel leniter curvata, 3–4 (plerumque 3)-septata, laevia, cellulis asalibus 2, brunneis, apicalibus 2–3, successive pallidioribus, 23–51 (plerumque o–35) × 6–8 μ. Cellula basalis appendice 1-cellulata subhyalina reflexa, conica, apice otundata, 4–6 μ longa, basi 5–5·5 μ crassa praedita.

Habitat in plagulis Scytonematacearum in foliis vivis *Culcasiae scandentis* (Araceae), old Coast Colony, Apremdo, 10. v. 1949, Herb. I.M.I. 43696(*a*) (typus).

Annellophora appendiculata forms dark brown epiphyllous colonies up to cm. in diameter in association with a blue green alga (Scytonemataceae).

The *mycelium* is composed of branched subhyaline to pale brown, eptate, smooth-walled, anastomosing hyphae 2–3·5 μ wide growing on he erect and repent filaments of the blue-green alga. Occasional hyphal ells are inflated and up to 9 μ in diameter; no hyphae were observed vithin the sheaths of the algal filaments.

The *conidiophores* arise singly or in groups of two to three; they are traight or curved, simple, with an intercalary basal foot cell, and then nore or less cylindrical and 3·5–5 μ wide, o- to 3-septate, thick-walled, rown but paler at the apex, 14–90 μ long, and they arise generally owards the apex of an erect algal filament. Towards the apex the conidiohores bear up to eighteen transverse darker coloured circular ridges at rregular or regular intervals, and these represent the scars of former ttachment of conidia through which the conidiophore has continued rowth.

The *conidia* arise by the blowing out of the apex of the conidiophore or its roliferations; a basal septum is laid down and a short lateral downwardly lirected appendage is soon cut off by a septum from the lower part of the nitial. The initial increases in length and three transverse septa bring the onidium to maturity; it appears to fall away readily. Proliferation through he old scar by the conidiophore finally results in a terminal conidium erminating the growth of the proliferation until the conidium has matured nd fallen and another proliferation commenced. Up to eighteen conidia can e produced by a single conidiophore by means of successive proliferation. Aature conidia are straight but slightly bent at the base, 23–51 (mostly o–35) μ long and 6–8 μ wide, obclavate, 3- (rarely 4-) septate, very slightly r not at all constricted at the septa, smooth, with the two lower cells rown, the penultimate pale brown or subhyaline, and the long subulate nd cell hyaline; the basal scar is flat and 3–4·5 μ wide; the lateral ppendage borne on the basal cell is more or less conical with a rounded pex, subhyaline, 4–6 μ long and 5–5·5 μ wide at the base.

(4) **Chaetotrichum macrosporum** Bonar

This is the second and only other species described in the genus *Chaetoichum* Sydow, by Bonar (1942). From the description and illustrations is considered that the species is based upon two different fungi; a similar ase is that of *Helminthosporium dendroideum* Berk. & Br. (1861) [e.g. Herb. M.I. 31696] which is based upon the conidiophores of *H. velutinum* and

Sporidesmium fusiforme and the conidia of the latter. In any case *Chaetotrichum macrosporum* Bonar is not an *Annellophora.*

My thanks are due to Mr E. W. Mason for correcting the Latin diagnoses

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Note added 15 September 1951

Petrak (*Sydowia*, v. pp. 30–39, July 1951) published 'Über die Gattungen *Chaetotrichum* Syd. und *Ragnhildiana* Solh.' He accepted the generic name *Chaetotrichum*, described six new species, and made three new combinations including *Chaetotrichum solani-torvi* (Frag. & Cif.) Petrak (syn. *Cercospora solani-torvi* Frag. & Cif.). Development of the conidia in this species is *Cercospora*-like and not like that of *Annellophora* spp.

STACHYLIDIUM, GONYTRICHUM, MESOBOTRYS, CHAETOPSIS AND *CHAETOPSELLA*

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(With 4 Text-figures)

Stachylidium bicolor is chosen as the lectotype species of the genus *Stachylidium* and is illustrated and described from temperate and tropical collections. *Gonytrichum caesium*, the type species of *Gonytrichum*, has been shown by Mr E. W. Mason to be based on the conidiophores of *Melanopsamella inaequalis*; the conidiophores are illustrated and described. The name *Mesobotrys* is based on the two species *M. macroclada* and *M. fusca*, which are here regarded as conspecific; furthermore, they are considered to be congeneric with *Gonytrichum caesium*; a new combination is proposed and the conidiophores and conidia described.

The type or lectotype species of these three generic names produce slimy amerospores from phialides.

Chaetopsis wauchii (= *C. grisea*) is the type species of *Chaetopsis*, and contrary to previous descriptions it has been found to produce slimy didymospores from polyphialides, and not amerospores.

Chaetopsella is regarded as a synonym of *Chaetopsis*, being based on *C. grisea* which is an earlier name for *C. wauchii*.

An attempt has been made to trace all British records of these fungi to their source. Nomenclators of all species attributed to the four generic names are given with the original substratum and country of origin.

STACHYLIDIUM

ink (1809) published his generic name *Stachylidium* for his two species, . *terrestre* and *S. bicolor*; both were compiled, amongst others, by Fries 1832, p. 391). The name *S. bicolor* has appeared not infrequently in uropean literature (e.g. Bainier, 1908; Berlese, 1888), but as far as I am ware *S. terrestre* has not been redescribed under this name. In Herb. .M.I. *S. bicolor* is chosen as lectotype species of the generic name *tachylidium*.

(1) **Stachylidium bicolor** Link ex Fr.

In Herb. I.M.I. there are thirty-four more or less recent collections ssigned to *S. bicolor*; of these twenty were made in England and the hannel Islands and thirteen in the tropics, mostly West Africa. These ollections agree with collection No. 910, 264–771 in Herb. Persoon in erb. Lugd. Bat. [9239*], which Mr Mason informs me is authenticated r the name *S. bicolor*, being so labelled by Link.

escription of Stachylidium bicolor (Fig. 1)

S. bicolor forms brown or olivaceous-brown colonies on various herbaceous r woody substrata, and they appear slimy when considerable numbers of onidia have been produced.

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* Every individual collection examined by the staff of the Commonwealth Mycological nstitute is given an accession number whether preserved in Herb. I.M.I. or some other erbarium. These accession numbers are quoted in this paper.

The *mycelium* is immersed and composed of hyaline to pale brown, frequently septate hyphae 2–6 μ wide and which tend to form extensiv almost pseudo-parenchymatous stromata beneath the surface layers o herbaceous hosts.

The *conidiophores* are formed singly or in groups, and are generall crowded, but occasionally scattered tufts of up to twenty conidiophore develop; they arise from submerged hyphal or stromatic cells. The mai stalk is regularly septate, unbranched, straight or gently curved, brown t dark brown at the base and paler at the apex, and usually uniforml roughened; its growth is terminated by the production of an apica phialide. The basal cell is slightly swollen, up to 10 μ wide, above whic the main stalk is 5–6·5 μ wide then tapering gradually to an apex 3–4 wide. The main stalk varies up to 700 μ long; immediately below th upper four to fourteen septa are borne verticils of either phialides o lateral branches. In most collections from Britain the verticils consis entirely of phialides but a lateral branch may develop in place of a phialid of one or more of the lower verticils; in most tropical collections, on th other hand, lateral branches are far more frequent so that a conidiophor may be almost arborescent. Each lateral branch is a minature main stal with verticils of phialides, and in some tropical collections, with eve secondary and tertiary lateral branches. *S. bicolor* is regarded here as bein very variable in its ability to produce lateral branches.

The *phialides* are oval to oval-cylindrical, constricted at the base an sometimes tapering at the distal end, rounded at the apex which bear a minute almost imperceptible collarette, developing singly or in verticil of up to five immediately below the septa. They are subhyaline to pal brown, paler than the conidiophore, uniformly roughened, 9–20 μ lon and 3·5–5 μ wide about half-way along their length, and form an angle o about 45–50° with the axis that bears them.

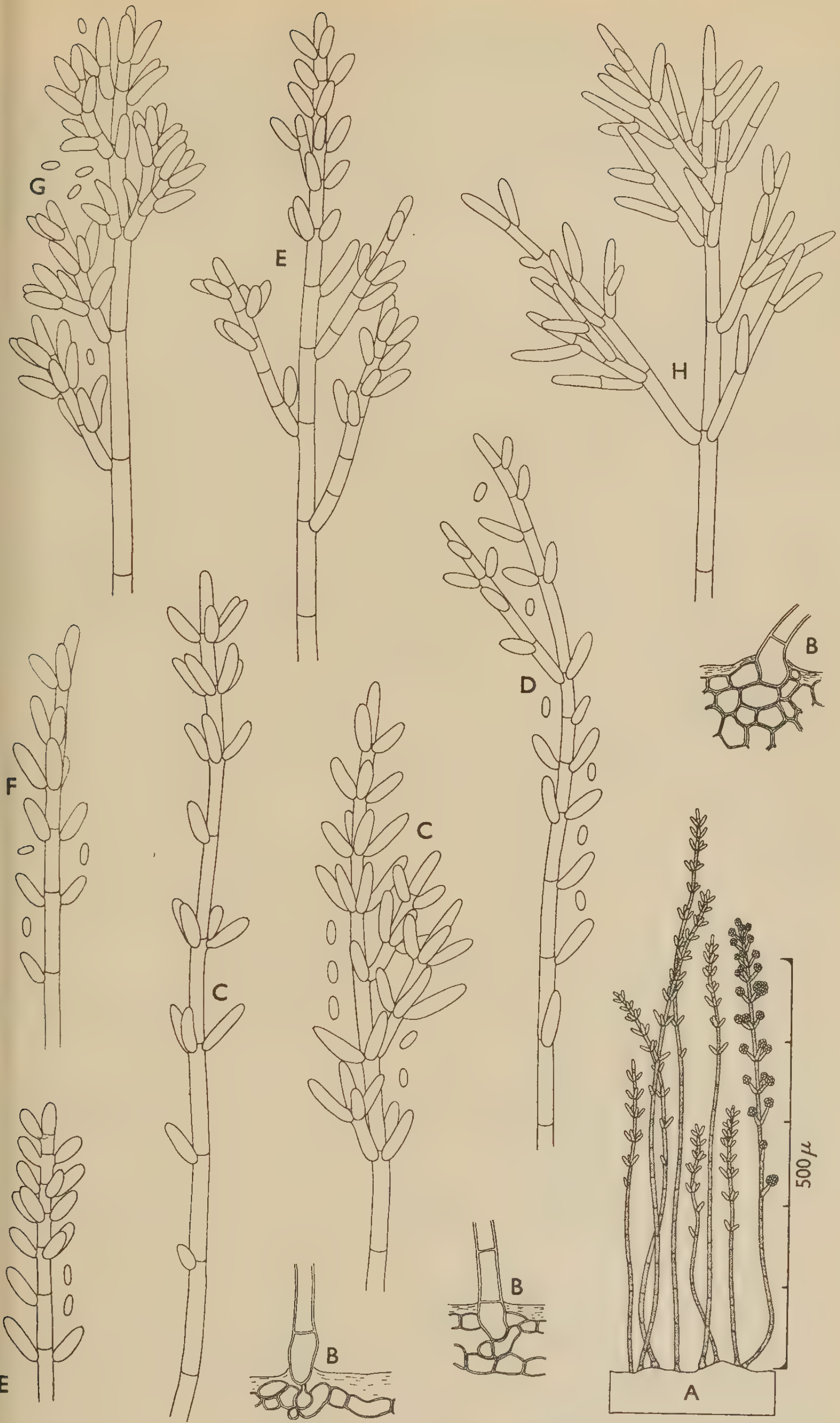
The *phialospores* are produced in basipetal succession in the open end o the phialide around which they form slimy heads, although such head can dry out. They are oval, subhyaline to pale brown, smooth, wit a refringent thickened area of cell wall at each end, 4–9 by 2–4 μ and eac has a narrow mucilaginous envelope.

Habitat: from the list of collections on pp. 554–555, it will be seen that thi mould can produce fructifications on a great variety of herbaceous an woody substrata. I suggest that it is more common in the Gold Coast tha in Britain.

Synonyms of Stachylidium bicolor

A. *Dematium verticillatum* Hoffm. In European fungus floras *D. verti-cillatum* Hoffm. (1795) is cited as a synonym of *Stachylidium bicolor* as wa done by Fries (1832); considering Hoffmann's diagnosis and figure this i probably correct. Modern ruling, however, would be against the takin up of Hoffmann's earlier epithet for *S. bicolor*. When Link compile *S. bicolor* in 1824 he stated 'An *Dematium verticillatum*? . . . quod simillimu est.'

B. *Acrostalagmus olivaceus* Corda (1838). I have not seen an authenticate collection, but Corda's description fits *Stachylidium bicolor* and so does hi



g. 1. *Stachylidium bicolor*. A, conidiophores and conidia from Herb. I.M.I. 19221 (*c*) on *Petasites ovatis*; B, bases of conidiophores from 19221 (*c*); C, fertile portion of two conidiophores from 19221 (*c*); D, from 39093 (*c*) on *Theobroma cacao*; E, from 42142 (*a*) on *Musa paradisiaca*; F, from 38178 (*a*) on wood and bark; G, from 38179 (*c*) on wood and bark; G, from 38179 (*c*) on wood and bark; H, from 37748 (*a*) on *Musa sapientum*; all × 500 except A which has a scale provided.

figure, especially with the cylindric-oval 'ramulis' [phialides]. The conid were stated to measure 4–5 μ long.

C. *Stachylidium fuscum* Cooke & Ellis (1879). The type collectio preserved in Herb. R.B.G. Kew has been examined [44798] and identified with *S. bicolor*, although the phialospores are rather sma measuring 4–5 by 2–2·5 μ.

British records sub Stachylidium bicolor

Gray (1821) compiled *S. bicolor* and described it as occurring 'on th stem of herbaceous plants'; I have not seen this collection.

Berkeley (1836, p. 341) listed the fungus 'on the stalks of herbaceou plants laid in heaps in gardens. Apethorpe, Norths, Margate, &c. Re M. J. Berkeley.' The Apethorpe collection is preserved in Herb. R.B.G Kew labelled by Berkeley '*Stachylidium bicolor* Lk. Apethorpe. Norths. herb. Berk.' [on herbaceous stem; 44793]; this is *S. bicolor*.

Also in 1836 (p. 335) Berkeley recorded *S. bicolor* in company wit *Pachnocybe albida* on rotten wood at King's Cliffe, Norths. This collectio is in Herb. R.B.G. Kew labelled by Berkeley '*Stachylidium bicolor* var. wit *Pachnocybe albida*' [on wood; 44794]; the collection bears *Stachylidiu bicolor* but I could see no *Pachnocybe albida*.

Adams & Pethybridge (1910) listed *Stachylidium bicolor* from Irelan I have not seen the collection.

Anon. (1943) recorded *S. bicolor* as one of the intercepted plant pests; was intercepted in California on *Cattleya* sp. from England. Apart fro this, there is no record of *Stachylidium bicolor* from England, Wales Scotland between 1836 and over a century later. It was found by E. W Mason in Yorkshire in 1944 and has since been identified on a number occasions.

Bramley *et al.* (*Naturalist, Lond.*, 1946, p. 79) recorded *S. bicolor* o *Heracleum* and *Petasites* from Yorkshire. These records refer to Herb. I.M. 1375 (*a*) and 1372 respectively and are *Stachylidium bicolor*.

Grainger *et al.* (*Naturalist, Lond.*, 1947, p. 90) recorded *S. bicolor* o *Heracleum* (twice), *Urtica* and *Pteridium* from Yorkshire. The records ref to Herb. I.M.I. 6795, 7335, 8127 and 6850 (or 8133) respectively, all which are *Stachylidium bicolor*.

Bramley & Grainger (*Naturalist, Lond.*, 1948, p. 79) recorded *S. bicol* on *Petasites* from Yorkshire. This record is based on Herb. I.M.I. 19221 (*c* which is *Stachylidium bicolor*.

Bramley & Grainger (*Naturalist, Lond.*, 1949, p. 82) recorded *S. bicol* on *Heracleum* and *Urtica* from Yorkshire and cited Herb. I.M.I. 31408 (*c* and 31407 (*b*) respectively, which are *Stachylidium bicolor*.

Recent collections assigned to Stachylidium bicolor *in Herb. I.M.I.*

(All numbers cited after the date of collection are accession numbers in Herb. I.M.I.

On *Dioscorea* sp. dead stems Dioscoreacea
Gold Coast Colony: Tafo, 16. vi. 1949, 41314 (S.J.H.).

On *Gardenia nitida* old fruits Rubiacea
Sierra Leone: Njala (Kori), 12. ix. 1949, 38340 (F.C.D.).

Heracleum sp. dead stems Umbelliferae

England: Forge Valley, Yorks, x. 1945, 1375(*a*) (S.J.H.); Mulgrave Woods, Yorks, 14. ix. 1946, 6795 (M.B.E.); Forge Valley, Yorks, 16. ix. 1946, 7335 (M.B.E.); Buff Wood, Cambs, 19. x. 1946, 8084 (S.J.H.); Masham, Yorks, 26. ix. 1948, 31408(*b*).
Channel Islands: Herm, 15. ix. 1948, 31656 (M.B. & J.P.E.).

Musa paradisiaca dead petioles Musaceae

Gold Coast Colony: Tafo, 16. vi. 1949, 42142(*a*) (S.J.H.).

M. sapientum dead leaves

Gold Coast Colony: near Bisa, 15. vi. 1949, 37748(*a*), 37750 (S.J.H.).

Oenanthe crocata dead stems Umbelliferae

Channel Islands: La Bouvée, Guernsey, 7. ix. 1948, 31664 (M.B. & J.P.E.); Marple Bay, Guernsey, 13. ix. 1948, 31661 (M.B. & J.P.E.).

Bambusa vulgaris dead stems Gramineae

British Togoland: Hohoe, 28. v. 1949, 37855(*b*) (S.J.H.).

Petasites ovatis dead petioles Compositae

England: Dalby Dale, Yorks, x. 1945, 1372 (W.G.B.); Masham, Yorks, 13. x. 1947, 19221(*c*) (S.J.H.); Masham, Yorks, 26. ix. 1948, 31455(*c*) (S.J.H.).

Populus sp. rotten wood Salicaceae

England: Wheatfen Broad, Norfolk, 7. iv. 1947, 14505 (E.A. & M.B.E.).

Pteridium aquilinum dead rachis Filicales

England: Forge Valley, Yorks, 16. ix. 1946, 6850, 8133 (S.J.H.).

Sambucus nigra dead branch Caprifoliaceae

Channel Islands: Bec du Nez, Guernsey, 29. ix. 1948, 31560 (M.B. & J.P.E.).

Sporobolus indicus dead leaves and culms Gramineae

Gold Coast Colony: Asuansi, 9. vi. 1949, 39626(*c*) (S.J.H.).

S. pyramidalis dead leaves and culms Gramineae

Gold Coast Colony: Apremdo, 10. v. 1949, 39672(*e*) (S.J.H.).

Theobroma cacao dead pods and leaves Sterculiaceae

Gold Coast Colony: Tafo, 14. vi. 1949, 39093(*c*) (S.J.H.).
Malaya: Kuala Gemuroh, Pohang, 29. x. 1947, 24899(*b*) (A.J.).

Urtica dioica dead stems Urticaceae

England: Kew, Surrey, ix. 1945, 855 (S.J.H.); Mulgrave Woods, Yorks, 18. ix. 1946, 8127 (M.B.E.); Masham, Yorks, 26. ix. 1948, 31407(*b*) (S.J.H.).

Umbelliferae, dead stems

England: Yorks, x. 1944, 854 (E.W.M.).

unidentified wood and bark

England: Wheatfen Broad, Norfolk, v. 1946, 5488 (S.J.H.); Kensington, London, 27. i. 1949, 33987 (M.F.M.).
British Togoland: Jasikan, 27. v. 1949, 41540 (S.J.H.).
Gold Coast Colony: near Bisa, 15. vi. 1949, 38179(*c*) (S.J.H.); Tafo, 14. vi. 1949, 38178(*a*) (S.J.H.).

nitials of the collectors in this list and those on pp. 563, 564 and 573 refer to P. K. C. stwick, W. G. Bramley, F. C. Deighton, T. W. Dunston, E. A., M. B. and J. P. Ellis, J. Hughes, A. Johnston, M. F. Madelin, E. W. Mason, F. Rilstone, J. Webster and T. Wei.

Species attributed to Stachylidium

Since 1809 thirty-one species and one variety have been attributed to th genus *Stachylidium.* For convenience, nomenclators of all these are give below in chronological order of their description in *Stachylidium* or of th new combination into this genus. The original substratum and country origin is given, together with a note on some of them; but the majority ar unknown to me.

(1) *Stachylidium bicolor* Link in *Mag. d. Gesellsch. Naturforsch., Freunde, Berli* **3**, 15, 1809.

≡ *Stachylidium bicolor* Link ex Fr. in *Systema mycologicum*, **3**, 391, 183

≡ *Botrytis bicolor* (Link) Pers. in *Mycologia europaea*, **1**, 37, 1822.

≡ *Acremonium bicolor* (Link ex Fr.) Bon. in *Handbuch der allgemeine Mykologie*, p. 92, 1851.

On dead stems of *Rheum undulatum.* Germany.

Bonorden (op.cit. p. 110) also compiled *Stachylidium bicolor* in *Stachylidiu* *S. bicolor* is the Herb. I.M.I. lectotype species of the genus.

(2) *Stachylidium terrestre* Link in *Mag. d. Gesellsch. Naturforsch., Freund Berlin*, **3**, 15, 1809.

≡ *Stachylidium terrestre* Link ex Fr. in *Systema mycologicum*, **3**, 391, 183

≡ *Botrytis terrestris* (Link) Pers. in *Mycologia europaea*, **1**, 38, 1822.

≡ *Verticillium terrestre* [(Link ex Fr.)] Sacc. in *Sylloge Fungorum* **4**, 15 1886 [as *V. terrestre* (Pers.) Sacc. syn. *Botrytis terrestris* Pers. i *Mycologia europaea*, **1**, 38].

On the ground. Germany.

(3) *Stachylidium candidum* Grev. in *Memoirs Wernerian nat. Hist. Soc.*, **4**, 7 1822.

On dead wood. Scotland.

In 1827 (Plate 257) Greville cited *S. candidum* as a synonym of *S. terrestr* Link (vide supra).

(4) *Stachylidium agaricinum* Fries in *Systema mycologicum*, **3**, 392, 1832.

On rotten agarics. Sweden.

(5) *Stachylidium diffusum* (Alb. & Schw.)Fries in *Systema mycologicum*, **3**, 39 1832.

≡ *Botrytis diffusa* Alb. & Schw. in *Conspectus fungorum*, p. 362, 1805.

≡ *Botryosporium diffusum* (Alb. & Schw.) Corda in *Sturm's Deutschland Flora*, iii Abt., Band **3**, p. 9, 1831.

On decaying stems of *Solanum tuberosum* heaped together. Germany.

(6) *Stachylidium sceptrum* Fries in *Systema mycologicum*, **3**, 390, 1832.

≡ *Sceptromyces opizi* Corda in *Sturm's Deutschlands Flora*, iii Abt., Band pp. 7–8, 1831.

≡ *Cephalosporium sceptromyces* (Corda) Bon. in *Handbuch der allgemeine Mykologie*, p. 108, 1851.

On the male inflorescences of Cypress in a hot-house. Czechoslovaki

Lindau (1907) considered this to be *Aspergillus niger. Sceptromyces opiz* is the type species of the generic name *Sceptromyces.*

7) *Stachylidium fulvum* Schw. in *Trans. Amer. phil. Soc.* (N.S.), **4**, 284, 1832.
≡ *Verticillium fulvum* (Schw.) Sacc. in *Sylloge Fungorum*, **4**, 157, 1886.

On rotten stems of *Brassica*. United States.

8) *Stachylidium lutescens* Schw. in *Trans. Amer. phil. Soc.* (N.S.), **4**, 284, 1832.
≡ *Verticillium lutescens* (Schw.) Sacc. in *Sylloge Fungorum*, **4**, 157, 1886.

On the ground, where masses of rotten branches have accumulated.

9) *Stachylidium roseum* Schw. in *Trans. Amer. phil. Soc.* (N.S.), **4**, 283, 1832.
≡ *Sporotrichum schweinitzii* Sacc. in *Sylloge Fungorum* **4**, 109, 1886.

On badly dried stems and leaves 'v.c. Solidaginis rigidae' in the erbarium. United States.

10) *Stachylidium characeum* Corda in *Icones fungorum*, i, p. 21, 1837.
≡ *Acrostalagmus characeus* (Corda) Sacc. in *Sylloge Fungorum*, **1**, 164, 1886.

On '*Sclerotium hippocastanum*'. Czechoslovakia.

11) *Stachylidium araucarium* (Corda) Bon. in *Handbuch der allgemeinen Mykologie*, p. 110, 1851.
≡ *Clonostachys araucaria* Corda in *Pracht-Flora europaeischer Schimmelbildungen*, p. 31, 1839. [≡ *Flore illustrée de Mucédinées d'Europe*, 1840.]

'On the window-sill between the two sashes of a double window maintained in a state of humidity; at an average temperature of 21° C. between nd upon pieces of flower pots filled with very rich, sifted and fine soil. zechoslovakia.'

This is the type species of the generic name *Clonostachys* Corda.

12) *Stachylidium cinnabarinum* (Corda) Bon. in *Handbuch der allgemeinen Mykologie*, p. 110, 1851.
≡ *Acrostalagmus cinnabarinus* Corda in *Icones fungorum*, **2**, 15, 1838.
≡ '*Verticillium cinnabarinum* [(Corda)] Reinke & Berthold.'

On rotten potatoes. Czechoslovakia.

This is the type species of *Acrostalagmus* Corda, and is considered to be ased on conidial *Nectria inventa* Pethybridge (see Hughes, *Mycol. Pap.*, .*M.I.*, **43**, p. 3, 1951).

13) *Stachylidium paradoxum* (Corda) Bon. in *Handbuch der allgemeinen Mykologie*, p. 330, 1851 (explanation to fig. 152).
≡ *Corethropsis paradoxa* Corda in *Pracht-Flora europaeischer Schimmelldungen*, p. 1, 1839. [≡ *Flore illustrée de Mucédinées d'Europe*, 1840.]

On fragments of flower pots in a damp atmosphere. Czechoslovakia.

As far as I am aware *C. paradoxa*, the type species of *Corethropsis* Corda, as not been redescribed under this name. From Corda's elaborate figure seems unlikely that it is a *Stachylidium.*

(14) *Stachylidium parasitans* (Corda) Bon. in *Handbuch der allgemeine* *Mykologie*, p. 110, 1851.

≡ *Acrostalagmus parasitans* Corda in *Icones fungorum*, **3**, 11, 1839.

On *Cephalosporium acremonium*. Czechoslovakia.

(15) *Stachylidium bassianum* (Bals.) Mont. in *Sylloge generum specierumqu* *cryptogarum*, p. 301, 1856.

≡ *Botrytis bassiana* Bals. in *Bibl. ital.* **79**, 125, 1835.

≡ *Beauveria bassiana* (Bals.) Vuill, in *Bull. Soc. bot. Fr.* **59**, 40, 1912.

On silkworms. Italy.

B. bassiana is one of the cotype species of *Beauveria* Vuill.

(16) *Stachylidium gregarium* Berk. & Curt. apud Berk. in *J. Linn. Soc. Lond* **10**, 362, 1869. On dead wood. Cuba.

(17) *Stachylidium extorre* Sacc. in *Michelia*, **1**, 84, 1877. On rotten woo of *Celtis australis*. Italy.

This is quite possibly identical with *Verticillium tenuissimum* Corda (se Hughes, *Mycol. Pap., C.M.I.*, **45**, p. 17, 1951).

(18) *Stachylidium thelenum* Sacc. in *Michelia*, **1**, 85, 1877.

≡ *Nodulisporium thelenum* (Sacc.) Smith in *Trans. Brit. mycol. Soc.* **34** 19, 1951.

On the bark of *Quercus* sp. in association with *Rosellinia thelena* (Fr. Rabenh. 'cujus statum conidicum sistit'. Italy.

The conidiophores and conidia on part of the type collection in Herb R.B.G. Kew (Saccardo, *Mycotheca veneta* 918) [44799] matches those found also with the perithecia of *Rosellinia thelena*, in Herb. I.M.I. 6428, o *Fagus sylvatica*, Glamorgan, Wales, 7. viii. 1946. However, the identity o the conidiophores with the perithecia has not been proved by cultures The conidial fungus cannot be classified as a *Stachylidium* because i produces its conidia not from phialides but from sporogenous cells, as th blown-out ends of successively produced growing points. The conidia scars are crowded at the apex of a mature sporogenous cell.

(19) *Stachylidium fuscum* Cooke & Ellis in *Grevillea*, **8**, (No. 45), 12, 187 On wood of *Magnolia*. United States.

As stated above (p. 554) I take this to be a later synonym of *Stachylidiu* *bicolor*.

(20) *Stachylidium trabeum* Berk. & Br. in *Ann. Mag. nat. Hist.* (Ser. 5), **7**, 131 1881.

≡ *Botrytis trabea* (Berk. & Br.) Sacc. in *Sylloge Fungorum*, **4**, 117, 188

On an old beam. England.

(21) *Stachylidium cyclosporum* Grove in *J. Bot., Lond.*, **22**, 199, 1884.

≡ *Verticillium cyclosporum* (Grove) Mason & Hughes apud Hughes i *Mycol. Pap. C.M.I.*, **45**, p. 19, 1951.

On a rotting stick. England.

This species has been redescribed by Hughes (op.cit.); it is not a *tachylidium.*

22) *Stachylidium chartarum* Schulz. & Sacc. in *Hedwigia*, **23**, 126, 1884. On rotting paper. Jugoslavia.

23) *Stachylidium variabile* Schulz. & Sacc. in *Hedwigia*, **23**, 126, 1884. On *Polyporus merismoides*. Jugoslavia.

24) *Stachylidium griseum* Berl. in *Fungi moricolae*, fasc. ii, no. 9, 1885. On rotten branches of *Morus alba*. Italy.

The arborescent conidiophores and phialides are stated to be minutely errucose; the illustrations are reminiscent of *Stachylidium bicolor* when much ranched.

25) *Stachylidium olivaceum* (Corda) Sacc. in *Sylloge Fungorum*, **4**, 332, 1886.
≡ *Acrostalagmus olivaceus* Corda in *Icones fungorum*, **2**, 15, 1838.
≡ *Cephalosporium olivaceum* (Corda) Bon. in *Handbuch der allgemeinen Mykologie*, p. 108, 1851.

On rotten wood of *Acer platanoides*. Czechoslovakia.

This name is very probably based on *Stachylidium bicolor.*

26) *Stachylidium extorre* Sacc. var. *majus* Berl. in *Fungi moricolae*, fasc. v, no. 19, 1888. On rotten wood of *Morus alba*. Italy.

27) *Stachylidium sambuci* Richon in *Catalogue raisonné des champignons de la Marne*, p. 448, 1889. On branches of *Sambucus nigra*. France.

28) *Stachylidium caricinum* Ell. & Everh. in *Proc. Acad. nat. Sci. Philad.* p. 377, 1894. On dead leaves of *Carex fraseri*. United States.

29) *Stachylidium depauperatum* Maire & Sacc. in *Saccardo's Sylloge Fungorum*, **16**, 1055, 1902. On dry spots on leaves of *Helleborus corsicus*, in socio *Septoria hellebori*. Corsica.

30) *Stachylidium formosum* Oud. in *Ned. kruidk. Arch.*, Ser. 3, p. 915, 1903. On various rotting leaves. Holland.

31) *Stachylidium geniculatum* (Preuss) Lindau in *Rabenhorst's Kryptogamen-Flora*, 2 Aufl., I (Pilze), viii, p. 740, 1907.
≡ *Acrostalagmus geniculatus* Preuss in *Linnaea*, **24**, 125, 1851.

On wood of *Alnus*. Germany.

32) *Stachylidium theobromae* Turconi in *Atti Ist. Bot. Pavia*, **17**, 7, 1920.
≡ *Verticillium theobromae* (Turc.) Mason & Hughes apud Hughes in *Mycol. Pap., C.M.I.*, **45**, p. 10, 1951.

On leaves of *Theobroma cacao* in socio *Physalospora theobromae* Turc. Italy Botanical Gardens).

(Rivolta [*Dei parassiti vegetali*...Ed. 2, p. 491] listed *Stachylidium arasitans* Hallier [a later homonym of *S. parasitans* (Corda) Bon.] and *. hageni* Hallier with a figure of each [Tab. vii, figs. 209 and 210] but with o diagnosis. I have not seen the first edition of this work.)

GONYTRICHUM

Nees, C. G. & F. (1818) published their generic name *Gonytrichum* for their single species *G. caesium*. In 1937 Mr E. W. Mason grew the ascospores of *Melanopsamella inaequalis* (Grove) v. Höhnel and obtained pure cultures of what had previously been assigned to *Gonytrichum caesium*. The particular collection Mr Mason used to show this connexion is Herb. I.M.I. 441, on oak wood, Bossal, Stamford Bridge, Yorks, coll. W. G. Bramley, 1937, and comprises perithecia only. No account of this has previously been published, but in Herb. I.M.I. all collections of *Gonytrichum caesium* are now disposed with *Melanopsamella inaequalis*. The generic name *Gonytrichum* was not taken up by Fries (1832); the generic citation will therefore be *Gonytrichum* Nees ex Wallroth (1833).

(2) **Melanopsamella inaequalis** (Grove) v. Höhnel

In the list of collections (pp. 563–564) maintained in the *M. inaequalis* folder in Herb. I.M.I. it is indicated which collections bear perithecia (P), or conidiophores and perithecia (PC).

Melanopsamella inaequalis (Grove) v. Höhn. in *Ann. mycol., Berl.*, **17**, 121, 1919.
≡ *Eriosphaeria inaequalis* Grove in *J. Bot., Lond.*, **24**, 132, 1886.
≡ *Lasiosphaeria inaequalis* (Grove) Massee in *Grevillea*, **16** (No. 78), 37, 1887.
= *Gonytrichum caesium* Nees in *Acta Acad. Caes. Leop.* **9**, 244, 1818.
≡ *Myxotrichum caesium* (Nees) Fries in *Systema Mycologicum*, **3**, 348, 1832.
= *Conoplea cinerea* Persoon in *Mycologia europaea*, **1**, 12, 1822.
≡ *Dematium cinereum* (Pers.) Sacc. in *Sylloge Fungorum*, **10**, 590, 1892.
= *Gonytrichum fuscum* Corda in *Icones fungorum*, **1**, 11, 1837.
? = *Gonytrichum erectum* Preuss in *Linnaea*, **24**, 110, 1851.

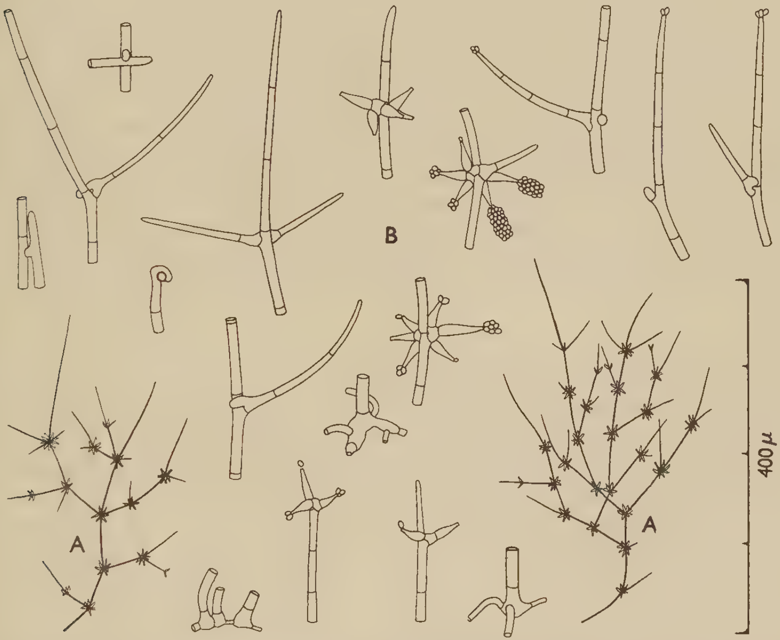
Description of conidial Melanopsamella inaequalis (Fig. 2)

M. inaequalis forms grey cushions of varying size, composed of crowded conidiophores; colonies may be as small as 0·5 mm. wide but are usually larger and by confluence sometimes extensive and up to a few centimetres wide. When old and devoid of phialospores the colonies become fuscous.

The *mycelium* is composed of mostly immersed but sometimes semi-immersed to superficial, branched, septate, hyaline to pale brown hyphae 1–2·5 μ wide.

The *conidiophores* arise singly or in groups from successive cells of a semi-immersed or superficial hypha; when arising singly the foot cell is swollen and irregularly lobed but usually only swollen when they arise in series; they are more or less erect, straight or slightly curved and generally geniculate at nodes which are 25–200 (mostly 40–60) μ apart, and from which nodes, laterals and phialides arise. The main stalk of the conidiophore is essentially unbranched, septate, up to 500 μ long, 2·5–3 μ wide

nd very dark brown for most of its length but paler towards the apex
hich is narrower and about 2 μ wide. One to three, usually one or two,
rimary lateral branches are borne at each node and stand out at an
ngle of 30–90° with the main stalk. Secondary, tertiary and even
uaternary laterals may be produced, and apart from their being succes-
vely shorter than the main stalk, they resemble it in geniculation and
rtile nodes. The laterals are as wide and darkly coloured, at their origin,
s the main stalk or lateral which bears them, and because of the genicula-
on at the nodes a dichotomously arborescent appearance is assumed.
usions of the H-type occur between laterals and occasionally the apex of
lateral coils around another; these anastomoses account for the difficulty



ig. 2. *Melanopsamella inaequalis* (conidial). A, two conidiophores from Herb. I.M.I. 19265 on *Fagus sylvatica*; B, portions of conidiophores showing bases, main stalks, with lateral branches and phialides arising from collar-like hyphae, conidia and anastomoses; all × 500 except A which have a scale provided.

xperienced in teasing apart a colony to isolate solitary conidiophores.
Jp to twelve radiating phialides are produced at each node, whilst the
pex of the main stalk or laterals may end in a single phialide, but the
pices are usually sterile and obtuse.

The *phialides* are more or less flask-shaped, subhyaline to pale brown
elow and hyaline at the apex which bears a collarette; they measure
–14 by 2–3 μ.

The *phialospores* are produced in basipetal succession from the open end
f the phialides, and either adhere together in the form of a ball at the end

of a phialide or develop into a column four to five phialospores wide they are hyaline, oval or oblong with rounded ends, smooth, and measure 2–3 by 1·5–1·8 μ.

Habitat: conidiophores have apparently been collected more frequentl than perithecia; both, however, occur in woodlands on the dead branches usually of broad-leafed trees, buried or partially buried in leaf mould.

Development of laterals and phialides follows the same pattern throughout an arborescent conidiophore, and in all cases they are produced at node but not directly on the main stalk or laterals. At any early stage, a bulge appears below a septum, and this elongates upwards, parallel with, or oblique to, the main stalk (or lateral) for a very short distance until it is level with, or just above, the septum. It then grows laterally and encircles the main stalk like a closely fitting collar. A lateral soon begins to develop from this collar-like hypha, and is usually quite long before the hypha has actually encircled the axis. The hypha becomes septate, subhyaline to brown, and one or two other laterals may develop; at the same time radiating phialides develop from the cells of the hypha which become somewhat swollen and may even proliferate. Occasionally a collar-like hypha bears only phialides. At maturity the laterals are as darkly coloured and as wide as the main stalk; some distortion of the original arrangement may occur so that the first lateral borne on the encircling hypha may appear to be borne directly on the main stalk as an immediate lateral branch.

British records sub Gonytrichum caesium

Berkeley (1836, p. 335) recorded *G. caesium* (as *Myxotrichum*) 'On rotten branches. Apethorpe, &c., Norths.' The Apethorpe collection referred to is probably that preserved in Herb. R.B.G. Kew [5154] and labelled by Berkeley '*Gonytrichum caesium* N. v. E. Apethorpe [on a twig]'; this is conidial *Melanopsamella inaequalis*.

Berkeley (1860, p. 353) recorded *Gonytrichum caesium* 'On fallen branches in wood'.

Cooke (1871, p. 613) recorded *G. caesium* 'On fallen branches. Apethorpe, &c'.

[Rabenhorst issued *Fungi europaei* 1881 in 1874 sub *G. caesium* and the collection was made at Batheaston by C. E. Broome. A copy is preserved in Herb. R.B.G. Kew [5144] and is *Melanopsamella inaequalis* (conidial)].

Grove (1886) described *Eriosphaeria inaequalis* with *Gonytrichum caesium* on rotten wood. There is a collection in Herb. W. B. Grove in Herb. Univ. Birmingham 'on dead wood (willow &c) Barnt Green Reservoir 29. 8. 85 [18224]' which may be the collection referred to; it is conidial *M. inaequalis*.

Massee (1893, p. 387) recorded *G. caesium* 'On fallen wood and branches'.

A. L. Smith (1904) recorded *G. caesium*, 'a somewhat rare fungus, from a Dumfriesshire Wood'; a slide from this collection preserved in Herb. Brit. Mus. (Nat. Hist.) has been examined and it is *Melanopsamella inaequalis* (conidial).

Crossland (1909, p. 320) recorded *Gonytrichum caesium* for the first time from Yorkshire; his collection is preserved in Herb. R.B.G. Kew [44969] and is *Melanopsamella inaequalis* (conidial).

Grainger *et al.* (*Naturalist, Lond.*, 1947, p. 90) recorded *Gonytrichum caesium* on *Sambucus*, bamboo, *Ulex* and unidentified wood. These records refer to Herb. I.M.I. 6796 (or 7280), 6937, 6981 and 7333 respectively, which are *Melanopsamella inaequalis* (conidial).

Bramley (*Naturalist, Lond.*, 1947, p. 162) recorded *Gonytrichum caesium* on *Fraxinus*, and the collection [13812] is preserved in Herb. I.M.I. as *Melanopsamella inaequalis* (conidial).

British records sub Gonytrichum fuscum

Berkeley & Broome (1865) recorded *G. fuscum* 'on dead sticks. Batheaston, C. E. Broome.' This collection is preserved in Herb. R.B.G. Kew [5169] labelled by Berkeley, *G. fuscum* 'Batheaston, Dec. 31. 1863, In *Rubum*. C.E.B.' It is *Melanopsamella inaequalis* (conidial).

Cooke issued *Fungi Britannici exsiccati* 348 sub *Gonytrichum caesium*; the collection was made at Swanscombe, August 1864. The Herb. R.B.G. Kew copy has been examined [5167] and it is *Melanopsamella inaequalis* (conidial).

Cooke (1871, p. 613) recorded *Gonytrichum caesium* 'on rotten sticks. Aug.' He cited his *Fung. Brit. Exsicc.* 348.

British records sub Melanopsamella inaequalis

Grove (1886) described his species *Eriosphaeria inaequalis* from a single collection 'In ligno putri, una cum *Gonytricho caesio* Nees, "Barnt Green". Ws., Aug.' I have not seen this collection.

Massee (1887) attributed *Eriosphaeria inaequalis* to *Lasiosphaeria*.

Bramley (*Naturalist, Lond.*, 1947, p. 161) recorded *Melanopsamella inaequalis* on *Betula* and this refers to Herb. I.M.I. 14110(*c*).

Bramley (*Naturalist, Lond.*, 1949, p. 12) recorded *Melanopsamella inaequalis* (conidial) on *Ulmus* and cited Herb. I.M.I. 27689.

Melanopsamella inaequalis has been recorded twice in recent forays (*Trans. Brit. mycol. Soc.*, **33**, 171 and 180, 1950) on wood and *Fraxinus* respectively. The collections referred to are Herb. I.M.I. 17561 and 28593.

Recent collections assigned to Melanopsamella inaequalis *in Herb. I.M.I.*

On bamboo

Mulgrave Woods, Yorks, 18. ix. 1946, 6937 (M.B.E.).

On *Betula*

Forge Valley, Yorks, 11. iv. 1947, (P) 14110(*c*) (S.J.H.).

On *Buxus sempervirens*

Mickleham, Surrey, 7. v. 1946, 5365 (S.J.H.).

On *Corylus avellana*

Ranmore, Surrey, 18. viii. 1946, 6419 (M.B.E.); 31. viii. 1947, 19066, 19098 (S.J.H.); Tubney Wood, Oxon, 18. ix. 1949, 37728 (M.B.E.).

On *Fagus sylvatica*

Ranmore, Surrey, i. 1943, 443 (E.W.M.); 31. viii. 1947, 19070 (S.J.H.); Boxhill, Surrey, 1. ix. 1946, 6669 (S.J.H.); Mickleham, Surrey, 7. v. 1946, 5363(*a*) (S.J.H.); Chipenham Fen, Cambs, 20. x. 1946, 7924 (M.B.E.); Swinton Park, Yorks, 11. x. 1947, 19265 (S.J.H.).

On *Fraxinus excelsior*

Thornton-le-Dale, Yorks, 13. iv. 1947, 13812 (S.J.H.); Ranmore, Surrey, 31. viii. 1947, 19476 (S.J.H.); Mistley, Essex, 8. v. 1948, 28593 (M.B.E.); Moulin Huet, Guernsey, 26, ix. 1948, (P) 33087 (M.B. & J.P.E.).

On *Larix europaea*

Moortown, Lincs, 27. ix. 1947, 17635 (J.W.).

On *Quercus* (British oak)

Ashtead Common, Surrey, 20. iv. 1946, 4580 (S.J.H.); 23. vi. 1946, 5902(*a*), 6675 (S.J.H.); Bagley wood, Oxon, 14. ix. 1947, 37604 (M.B. & J.P.E.); Gt Bookham Common, Surrey, 22. vi. 1947, 16007 (S.J.H.); Sellers wood, Devon, 17. ix. 1947, (P) 17561 (M.B.E.); Stamford Bridge, Yorks, x. 1937, (P) 440, (P) 441 (W.G.B.); Tothill, Surrey, 7. vii. 1946, 6565 (M.B.E.).

On ?*Rhamnus frangula*

Wicken Fen, Cambs, 28. xi. 1949, 38946 (P.K.C.A.).

On *Rhododendron*

Richmond Park, Surrey, 20. vi. 1946, 5733 (S.J.H.).

On *Ribes grossularia*

Perranzabuloe, Cornwall, 1. i. 1945, 495 (F.R.).

On *Sambucus nigra*

Ashtead Common, Surrey, 4. x. 1947, (PC) 19164 (S.J.H.); Mulgrave woods, Yorks, 13. ix. 1946, 6796, 7280 (M.B.E.).

On *Taxus baccata*

Ranmore, Surrey, 31. viii. 1947, 19067 (S. J. H.).

On *Ulex europaeus*

Gt Hampden Common, Bucks, 16. ix. 1949, 37727 (M.B. & J.P.E.); Herm, Channel Islands, 15. ix. 1948, 31691 (M.B. & J.P.E.); Skelder Plantation, Yorks, 15. ix. 1946, 6981 (M.B.E.).

On *Ulmus* sp.

Lessness woods, Kent, iii. 1926, (P) 5243 (E.W.M.); Roche Abbey, Yorks, iv. 1948, 27689 (S.J.H.).

On unidentified wood and bark

Mulgrave woods, Yorks, 13. ix. 1946, 7333 (M.B.E.); Ranmore, Surrey, 31. viii. 1947, 19068 (S.J.H.); 13. vi. 1948, 29350 (S.J.H.); Rurhlo, Holland, ix. 1935, 442 (E.W.M.); Shrawley, Worcs, viii. 1944, (PC) 439 (E.W.M.); Wheatfen Broad, Norfolk, v. 1946, 5495 (S.J.H.).

Two collections of historical interest

(*a*) In Herb. Persoon in Herb. Lugd. Bat., collection No. 910, 263–425 is authenticated for the name *Conoplea cinerea* Pers. [9119]; it is conidial *Melanopsamella inaequalis*. Mr E. W. Mason informs me that Persoon's species was misidentified by Fries (1832, p. 491) from Persoon's three-word diagnosis.

(*b*) In Herb. R.B.G. Kew is preserved a collection [5157] labelled by Corda '*Gonatotrichum caesium* Nees, Ca'. In view of the fact that the resumed type of *G. fuscum* has been examined and found to be conidial *Melanopsamella inaequalis* it is of interest to know that his collection of *Gonatotrichum caesium* also bears the same fungus.

pecies attributed to Gonytrichum

Since 1818 six species have been attributed to *Gonytrichum*. Nomenclators f these are given below, except where included on p. 560, with the original ubstratum and country of origin.

1) *Gonytrichum caesium* Nees, C.G. & F. (typus; see p. 560). On rotten branches and fruits of *Quercus*. Germany.

I have not seen any material authenticated for this name, but Nees's gures are very suggestive of conidial *Melanopsamella inaequalis*.

2) *Gonytrichum fuscum* Corda (see p. 560). On rotten branches of broad leaved trees. Czechoslovakia.

Herb. cryptogam. Mus. Nat. Praha, Czechoslovakia, No. 515147 is resumably the type collection; it is labelled *G. fuscum* by Corda and the iece of bark bears perithecia and conidiophores of *M. inaequalis* [44407].

3) *Gonytrichum gilvum* Rabenh. in *Deutschlands Kryptogamen-Flora*, 1 (Pilze), p. 105, 1844. On fallen branches of fruit trees. Italy (Como).

4) *Gonytrichum erectum* Preuss (see p. 560). On rotten branches of *Rubus idaeus*. Germany.

I have seen no authentic material, but Preuss's description (loc.cit., 851) and figure (1862) are very suggestive of conidial *Melanopsamella naequalis*.

5) *Gonytrichum rubrum* Patouillard apud Pat. & Lagerh. in *Bull. Soc. mycol. Fr.*, 7, 181, 1891. On rotten roots of *Anemone coronaria*. Ecuador.

Except for its colour, this was stated to resemble *Gonytrichum caesium*.

6) *Gonytrichum luteo-viride* Torrend in *Broteria*, **12**, 68, 1914. On the cortex of *Salix* sp. Portugal.

(7) *Chaetopsis macroclada* Sacc. (= *C. fusca* Corda) is attributed to *Gonytrichum* below.]

(3) **Gonytrichum macrocladum** (Sacc.) Hughes comb.nov.

≡ *Chaetopsis macroclada* Sacc. in *Michelia*, **1**, 79, 1877.
≡ *Mesobotrys macroclada* (Sacc.) Sacc. in *Michelia*, **2**, 27, 1880.
= *Chaetopsis fusca* Corda in *Icones fungorum*, **1**, 18, 1837.
≡ *Mesobotrys fusca* (Corda) Sacc. in *Michelia*, **2**, 27, 1880.

It will be observed that Corda's epithet *fusca* is earlier than Saccardo's *macrocladum* but it is unavailable for transference to *Gonytrichum* because the inomial *G. fuscum* has already been published by Corda (1837) for nother species (see above).

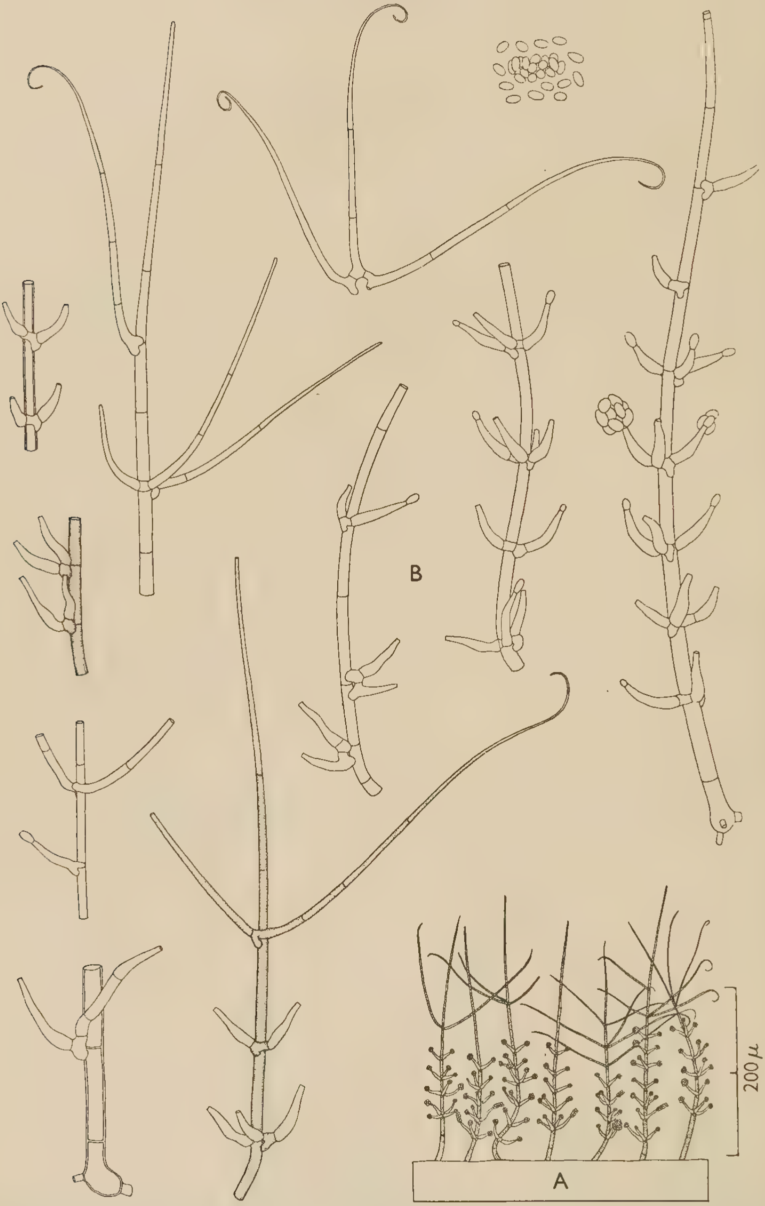


Fig. 3. *Gonytrichum macrocladum.* A, B, conidiophores and conidia from Herb. I.M.I. 1473 on bamboo; all × 500 except A which has a scale provided.

Description of Herb. I.M.I. 1473 (Fig. 3)

The *colonies* are effuse and olivaceous.

The *mycelium* is mostly immersed and composed of subhyaline to brown, branched, septate hyphae 2–3 μ wide.

The *conidiophores* are crowded but arise singly and are composed of a simple erect main stalk which is 250–320 μ long, septate, dark brown, swollen to 5–8 μ at the base, then 4–6 μ wide and tapering subulately and becoming paler towards the 1–1·5 μ wide apex. Indirectly on the lower half of the conidiophore, at nodes at intervals of between 18–40 μ, are borne four to eight whorls each with up to six phialides; above are borne, also indirectly, one to three whorls of one to four divergent setae, although these may be absent. These whorls of phialides and setae are borne on brown septate hyphae which arise singly below a septum and which closely encircle the main stalk of the conidiophore.

The *setae* when produced are brown below and taper subulately towards a hyaline often uncinate apex, are 70–170 μ long and are directed upwards at an angle of about 80–45° to the main stalk.

The *phialides* are more or less subulate, 12–19 μ long and 3–3·5 μ wide, subhyaline to pale brown below and hyaline at the apex, with a collarette; they are straight or curved, and are directed upwards generally at an angle of 45° to the main stalk.

The *phialospores* are oval, continuous, subhyaline to very pale olivaceous, sometimes inconspicuously flattened at one end, 3·5–4·5 by 2–2·5 μ, produced in a slimy mass at the apex of the phialides or in a straight or curved column two or three conidia wide.

Habitat: on that part of a dead bamboo cane which was buried in damp earth, Lambourne Hill, Perranzabuloe, W. Cornwall, England; collected by F. Rilstone, 27. viii. 1944; Herb. I.M.I. 1473.

Goidànich (1933) gave a redescription of *Mesobotrys macroclada* based upon a fresh collection which was compared with one from Saccardo's herbarium. Herb. I.M.I. 1473 agrees comfortably with Goidànich's description. He observed that the phialides are borne in a curious manner but neither description nor illustration makes the point clear.

Development of phialides. In all published illustrations of this fungus known to me, the phialides are shown to be borne directly on the erect conidiophore. Close examination of the fungus, however, shows that this is not the case. At an early stage in development when the conidiophore is a simple, erect, septate, brown hypha, a small bulge appears at first below one of the lower septa; this develops into a brown hypha, narrower than the main stalk and which grows abruptly upwards and then turns to one side and eventually encirles the main stalk like a collar, and at all times closely adpressed to it. In the meantime it develops septa and phialides develop from the constituent cells. Four to eight such fertile hyphae develop on a main stalk, and no phialides develop directly on the main stalk. Occasionally a potential phialide may grow out into a short hypha which becomes 1- or 2-septate and develops a terminal phialide.

Development of apical setae. These, too, have been illustrated in the past as having developed directly from the main stalk of the conidiophore but they arise like the phialides. A collar-like hypha arises, as explained above and instead of phialides developing, setae grow up to 170 μ long and remain sterile. In the uppermost one or two whorls of phialides, it is not uncommon for a seta to develop instead of a phialide but on the whole the conidiophores are quite regular, with lower whorls of phialides and upper whorls of setae; sometimes setae fail to develop.

Gonytrichum macrocladum *in culture*

I have not grown *G. macrocladum* from host material, but two isolations from soil in North America are assigned to this name.

On potato-dextrose agar abundant conidiophores and conidia with but little aerial mycelium had developed after four months giving dark brown colonies. The main axis of the conidiophores is longer and more attenuated than in host material, but the charateristic nodes are produced and the development of the collar-like hyphae can be followed very easily; phialides and setae arise on the hyphae either on their own or mixed together. Setae are produced more abundantly in culture than in nature, and they are not restricted to upper nodes.

Collections assigned to Gonytrichum macrocladum

(1) Herb. I.M.I. 1473, details of which are given above.

(2) Dried cultures. Isolated from soils of Southern California (United States) by J. P. Martin (culture D. 3). Herb. I.M.I. 19854, received with letter dated 2. xii. 1947.

(3) Dried cultures. Isolated from soil (? Ontario) by R. G. Atkinson, Department of Agriculture, St Catherines, Ontario, Canada. Herb. I.M.I. 41742, received 7. vi. 1950.

(4) Herb. cryptogam. Mus. Nat. Praha, Czechoslovakia, No. 515142. This, the presumed type collection of *Chaetopsis fusca* [44407], was assigned to this name by Corda. It has not preserved well and the conidiophores are mostly broken; collar-like hyphae with phialides are present, however, and the few phialospores seen measure 3·8–4 by 2–2·2 μ. I saw no apical setae but these are not always produced in Mr Rilstone's collection; *C. fusca* is considered to be identical with *C. macroclada* and the collections mentioned above.

The systematic position of Gonytrichum macrocladum

At first sight it would appear that the fungus described above is generically distinct from *G. caesium*. Closer examination shows that they have distinct characters in common, and the most important of these is the development of single collar-like hyphae below septa of the main stalk (and laterals in *G. caesium*), and on which are borne phialides or setae or indeed both. The main stalk is thus virtually unbranched. The phialospores of both are slimy amerospores. The differences would appear to me to be specific if the presence of the collar-like fertile hyphae at nodes is made the diagnostic feature of the genus *Gonytrichum*.

MESOBOTRYS

The generic name *Mesobotrys* was published by Saccardo (1880) for two species thus: '*Mesobotrys* Sacc. Hyphae *Chaetopsidis*; conidia ovoidea.—Ex. *M. macroclada* Sacc., *M. fusca* Corda, sub *Chaetopside.*'—I consider these two cotype species to be based on the same fungus which is attributed above to *Gonytrichum macrocladum* and I regard *Mesobotrys* as a later synonym of *Gonytrichum.*

Since 1880, five species and one variety have been attributed to *Mesobotrys*. Except for the cotype species mentioned on p. 565, nomenclators of the six names are given below with the original substratum and country of origin.

(1) *Mesobotrys macroclada* (Sacc.) Sacc. (see p. 565). On rotten wood of *Quercus*. Italy.

(2) *Mesobotrys fusca* (Corda) Sacc. (see p. 565). On rotten pine wood near Reichenberg. Czechoslovakia.

(3) *Mesobotrys fusca* var. *brachyclada* Sacc. in *Sylloge Fungorum*, **4**, 324, 1886. On rotten branches of *Quercus*. Italy.

(4) *Mesobotrys graminicola* (Berk. & Br.) Sacc. in *Sylloge Fungorum*, **4**, 325, 1886.

≡ *Chaetopsis graminicola* Berk. & Br. in *J. Linn. Soc. Lond.* **14**, 90, 1873.
≡ *Lacellina graminicola* (Berk. & Br.) Petch in *Ann. R. bot. Gdns Peradeniya*, **9**, 171, 1924.

I made two collections of this fungus on *Saccharum officinarum* leaves in the Gold Coast in 1949 (Herb. I.M.I. 38568(*c*), 38596(*c*)) and these are disposed as *Lacellina graminicola*. The fungus is quite distinct from the type species of *Mesobotrys* and *Chaetopsis*.

(5) *Mesobotrys flavovirens* v. Höhn in *S.B. Akad. Wiss. Wien*, Abt. i, **111**, p. 1048, 1902. On rotten wood. Austria.

(6) *Mesobotrys simplex* Gilm. & Abb. in *Iowa St. Coll. J. Sci.* **1**, 139, 1927. Isolated from soil in Louisiana. United States. This is reminiscent of *Gonytrichum macrocladum*.

CHAETOPSIS

Greville (1825) published the generic name *Chaetopsis* for his single species *C. wauchii*, which thus ranks as the type species. In all published works the fungus has been classified amongst the Amerosporae, but in reality the conidia possess a median septum which becomes clearly visible when conidia are mounted in warmed lactic acid tinged with cotton blue. In Herb. I.M.I. *C. wauchii* is regarded as a later synonym of *C. grisea* for reasons to be given below. The generic name *Chaetopsis* was not taken up by Fries (1832); the generic citation will therefore be *Chaetopsis* Grev. ex Corda (1837).

(4) **Chaetopsis grisea** (Ehrenb.) Sacc. in *Michelia*, **2**, 26, 1880.
≡ *Chloridium griseum* Ehrenb. in *Sylv. mycol. Berol.* p. 23, 1818.
≡ *Dematium griseum* (Ehrenb.) Pers. in *Mycologia europaea*, i, p. 15, 1822.
≡ *Dematium griseum* (Ehrenb.) Pers. ex Fr. in *Systema mycologicum*, **3**, 364, 1832.
≡ *Chaetopsella grisea* (Ehrenb.) v. Höhnel in *Mitt. bot. Lab. tech. Hochsch. Wien*, **7**, 1 Heft, p. 44, 1930.
= *Chaetopsis wauchii* Greville in *Edinb. Phil. J.* **13**, 63, 1825.
≡ *Dematium wauchii* (Grev.) Berk. in *Smith's English Flora*, v, Part ii, p. 338, 1836.
= *Chaetopsis stachyobola* Corda in *Icones fungorum* **3**, 8, 1839.

Description of Chaetopsis grisea (Fig. 4)

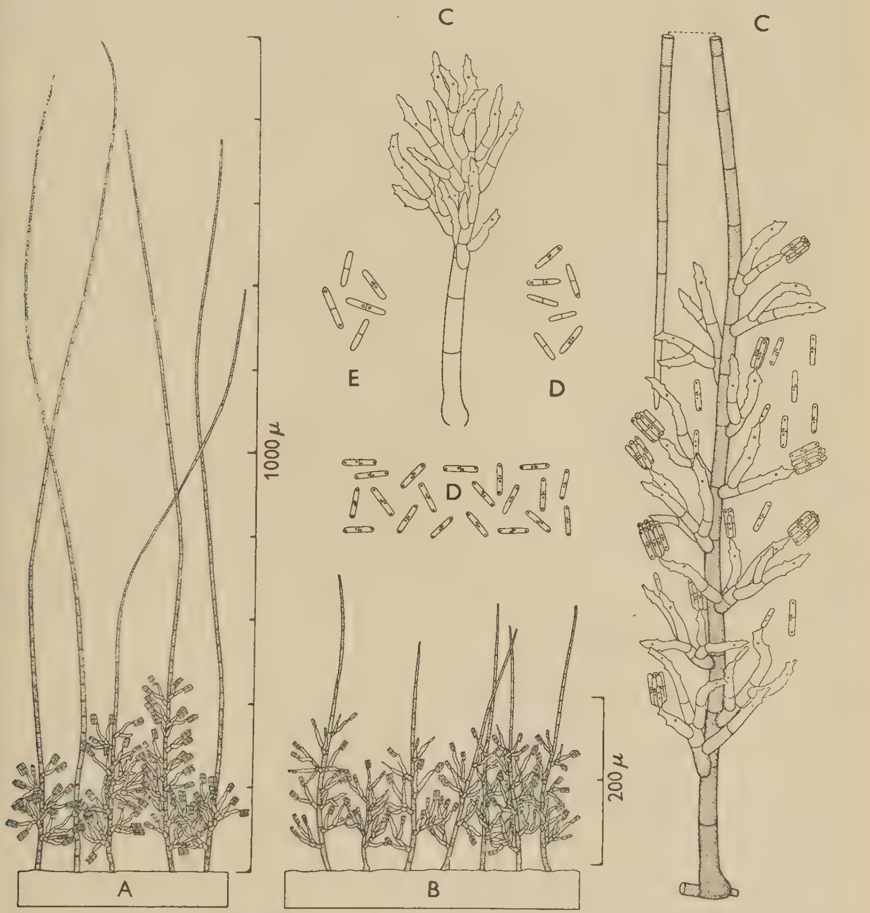
C. grisea forms greyish colonies on the wood and bark of broad-leaved trees; on dispersal of the conidia, the colonies become fuscous.

The *mycelium* is immersed and composed of hyaline to pale brown, branched, septate hyphae 2–4 μ wide.

The *conidiophores* are formed singly from immersed or semi-immersed hyphae and are crowded on the substratum. The main stalk is regularly septate, unbranched, rigid, usually straight, 200–1000 μ long, dark brown and 5–8 μ wide just above the foot cell which is 9–10 μ wide, tapering subulately and becoming paler towards a subhyaline apex which is 1·8–2 μ wide. Towards the base of the main stalk, and below three to twenty-one successive septa, are produced single or paired primary lateral branches. These usually form an angle of about 30–60° with the main stalk, are concolorous with it or slightly paler, regularly septate and up to 150 μ long, although the upper laterals are shorter than the lower ones; they generally bear, below the septa, short secondary laterals which are up to 35 μ long, continuous or up to 3-septate. The primary and secondary lateral branches usually end in solitary polyphialides, although sometimes their apices grow forward as sterile setae thus resembling the main axis with its sterile apex. Occasionally the sterile prolongation of the main stalk is absent and the main stalk is terminated abruptly by a polyphialide.

The *polyphialides* (Hughes, 1951) are more or less cylindrical, straight or curved, up to 25 μ long, subhyaline or pale brown at the base and hyaline towards the apex; they bear a short terminal collarette and up to six similar lateral ones. Young and consequently short polyphialides bear fewer collarettes, so I consider that open ends are each in turn terminal, and then are pushed aside by forward growth due to the production of a lateral or subapical growing point; a new open end with its collarette develops at the new apex and by a repetition of this process up to six collarettes are found on a mature polyphialide.

The *phialospores* are produced in basipetal succession in the terminal open end of the polyphialides, and form a compact bundle of parallel phialospores which stick together presumably by virtue of their being slimy. They are more or less cylindrical, rounded at both ends, hyaline, with a median septum and they measure 8–12 by 1·8–2 μ; they frequently possess two polar guttules and one on each side of the septum. Examination f conidiophores on a dry slide shows that the bundles of phialospores are orne singly at the apex of each polyphialide. From this I gather that the pen ends cease to function when a new open end develops, and the bundle f phialospores produced from the previous one is carried forward by the longating polyphialide to join with other phialospores produced from he new open end.



ig. 4.—*Chaetopsis grisea.* Conidiophores and conidia, A, from Herb. I.M.I. 14024 (*b*) on *Fraxinus excelsior*; B, from 13929 (*c*) on *Fagus sylvatica*; C, from 13929 (*c*); D, conidia from Greville's collection of *Chaetopsis wauchii* Grev. [Herb. I.M.I. (slide) 48811]; E, conidia from Corda's collection of *C. stachyobola* Corda [Herb. I.M.I. (slide) 44406]; all × 500 except A and B which have a scale provided.

Habitat: *C. grisea* has been found in Britain in woodlands, on the wood nd bark of *Fagus sylvatica*, *Fraxinus excelsior*, *Ulmus* sp. and unidentified ranches on the ground.

xplanation of synonymy

A. *Chaetopsis grisea.* Fries (1832, p. 364) cited *C. wauchii* as a synonym f *Dematium griseum* (Ehrenb.) Pers. which is a transfer from *Chloridium.*

No material authenticated for the name *C. grisea* has been seen, bu Ehrenberg's diagnosis would not exclude what had formerly been assigne to *C. wauchii* in Herb. **I**.M.I.; furthermore, there has been almost universa acceptance of the synonymy of *C. grisea* and *C. wauchii.* v. Höhnel (1930 however, treated them as distinct but described the conidia of *C. grisea* a 2-celled (see p. 573).

B. *Chaetopsis wauchii.* Through the kindness of Sir W. Wright Smith Regius Keeper of the Royal Botanic Garden, Edinburgh, I was permitte to examine a collection labelled as follows by Greville '*Chaetopsis wauch* Grev. Capt.n Wauch. 1824' [44811]. Some conidia from this collection which is probably the type, are illustrated in Fig. 4D.

C. *Chaetopsis stachyobola.* Herb. cryptogam. Mus. Nat. Praha, Czecho slovakia, No. 515143 is presumably the type collection of *C. stachyobol* (44406) and is labelled by Corda '*Chaetopsis stachyobola* Ca, Lobkowitz Garten, April 1837'. Some conidia from this collection are illustrated i Fig. 4E; they measure 8–12 by 1·8–2 μ. The fungus agrees perfectly wit the Greville collection and with the more or less recent collections liste on p. 573.

The single British record sub Dematium griseum

Berkeley (1836, p. 337) regarded *Chaetopsis wauchii* as a synonym o *Dematium griseum* but drew attention to the fact that Greville illustrate oval conidia in 1826, although in 1825 he had described them as 'oblongo cylindrica'; Berkeley stated that the conidia in his collection were si times as long as they were broad. He thought it might be possible tha Greville's species was distinct 'and if this should be the case it would bea the name of *Dematium wauchii* [comb. nov.]'. I have not traced Berkeley' collection from Fineshade, Norths.

British records sub Chaetopsis wauchii

Greville (1825) described his species, and the presumed type has bee examined (see above).

Greville (1826) cited the same collection as he did in 1825.

Berkeley (1860, p. 353) described *C. wauchii* as occurring 'on decaye wood'.

Cooke (1871, p. 614) compiled *C. wauchii* 'on decayed wood' and cite *Dematium griseum* as a synonym.

Stevenson (1879, p. 285) recorded the fungus 'on decayed sticks, Tweed Forth, Moray'. There are two collections in Herb. R.B.G. Kew, on collected by J. Keith (presumably from Scotland), Dec. 1873, determine as *Chaetopsis wauchii* by Berkeley [44795], and the other determined b Cooke and also collected by J. Keith, 7. i. 1876, Forres [1693]; both ar *C. grisea* but there is no evidence that Stevenson's records were based o either.

Massee (1893, p. 385) compiled *C. wauchii* 'on rotten trunks, &c', an cited *C. grisea* as a synonym.

Bramley (*Naturalist, Lond.*, 1947, p. 162) recorded *C. wauchii* on *Fagu* and *Fraxinus* from Yorkshire; the records refer to Herb. I.M.I. 13928 (*c* (or 13929 (*c*)) and 14024 (*b*) respectively and are now referred to *Chaetopsis grisea.*

Recent collections assigned to Chaetopsis grisea *in Herb. I.M.I.*

On *Fagus sylvatica* wood and bark

Tothill, Surrey, 7. vii. 1946, Herb. I.M.I. 6054(*b*) (S.J.H.); Howldale, Yorks, 12. iv. 1947, 13928(*c*), 13929(*c*) (S.J.H.), 14461 (M.B.E.); Ranmore Common, Surrey, 23. i. 1949, 33716 (S.J.H. & C.T.W.).

On *Fraxinus excelsior* wood and bark

Forge Valley, Yorks, 11. iv. 1947, 14460 (M.B.E.); Howldale, Yorks, 12. iv. 1947, 14024(*b*) (S.J.H.); Ranmore Common, Surrey, 23. iii. 1947, 12758 (M.B.E.).

On *Ulmus* sp. wood and bark

Thornton-le-Dale, Yorks, 28. iv. 1946, 4901 (S.J.H.).

On unidentified branch

Donhead St Mary, Wilts, xii. 1945, 13278 (T.W.D.).

Species attributed to Chaetopsis

Since 1825 eight species have been attributed to the genus *Chaetopsis.* Nomenclators of some of these have already been given above, together with the original substratum and country of origin; those not previously mentioned are cited below.

(1) *Chaetopsis wauchii* Greville (see p. 570). On rotten wood. Scotland.

(2) *Chaetopsis fusca* Corda (see p. 565). On rotten pine wood near Reichenberg. Czechoslovakia.

(3) *Chaetopsis stachyobola* Corda (see p. 570). On small fallen branches of *Carpinus betulus.* Czechoslovakia.

(4) *Chaetopsis ulicis* Crouan P.L. & H.M. in *Florule du Finistère*, p. 12, 1867.

≡ *Dactylium ulicis* (Crouan) Sacc. in *Sylloge Fungorum*, **10**, p. 551, 1892.

On the still green leaves of a fallen branch of *Ulex.* France. The conidia were described with up to eight septa.

(5) *Chaetopsis graminicola* Berk. & Br. (see p. 569).

(6) *Chaetopsis macroclada* Sacc. (see p. 565).

(7) *Chaetopsis grisea* (Ehrenb.) Sacc. (see p. 570). Ehrenberg gave no substratum. Germany.

(8) *Chaetopsis roseola* Ell. & Everh. in *Proc. Acad. nat. Sci. Phil.*, p. 376, 1894. On oak bark. United States.

CHAETOPSELLA

v. Höhnel† (1930) published the generic name *Chaetopsella* for the single species *Chloridium griseum* with this diagnosis 'Wie *Chaetopsis* Grev. aber Sporen zylindrisch, zweizellig.' He considered *C. wauchii* to be distinct from *Chloridium griseum* because the latter has 2-celled conidia and the former elliptical 1-celled conidia; furthermore, he stated that *Chaetopsis fusca* is obviously the same as *C. wauchii.* He commented on the fact that Saccardo had proposed the genus *Mesobotrys* for *Chaetopsis macroclada* and *C. fusca* (which v. Höhnel thought to be very closely related) and continued by citing *Mesobotrys* as a synonym of *Chaetopsis*. v. Höhnel's arrangemen would therefore be as follows:

Chaetopsella	**Chaetopsis** (syn. *Mesobotrys*)
C. grisea (Ehrenb.) v. Höhn.	*C. wauchii* Grev. (syn. *C. fusca*) *C. macroclada* Sacc.

This is the first time that 2-celled conidia had been attributed t *Chloridium griseum* Ehrenb. Examination of the presumed type of *Chaetopsi wauchii* (p. 572) shows that the conidia agree with Greville's (1825 diagnosis ['oblongo-cylindrica'] in that they are cylindrical but they ar 2-celled and not 'uniloculata'. Greville's figure (1826) shows long-ova conidia but in this publication too, he described them as oblong. Therefor accepting *Chloridium griseum* as identical with *Chaetopsis wauchii*, I conside *Chaetopsella* to be a synonym of *Chaetopsis*.

SYSTEMATIC SUMMARY OF GENERIC NAMES

Stachylidium Link ex Fr. Herb. I.M.I. lectotype species, *S. bicolor*.

Main stalk of conidiophore unbranched, straight, simple or bearin solitary or paired primary, secondary and tertiary lateral branches belo septa towards the distal end.

Phialides oval or cylindric-oval produced terminally on main stalk an lateral branches and in verticils below the septa. Collarette inconspicuous

Phialospores oval, slimy, 1-celled, pale brown to brown.

Gonytrichum Nees ex Wallr. Type species, *G. caesium*.

Main stalk of conidiophore unbranched, straight or geniculate, bearin below a number of septa single collar-like hyphae from which primar lateral branches arise either along the length of the main stalk or restricte to the distal end; lateral branches may be absent altogether. Secondary tertiary and even quaternary lateral branches, when present, develop i the same way from collar-like hyphae. Conidiophores may thus appea arborescent or more or less simple with or without lateral branches above The ends of the main stalk and laterals are usually sterile.

Phialides produced from the collar-like hyphae and are more or les flask shaped with a well-marked collarette.

Phialospores subglobose to oval, slimy, continuous, hyaline to pale brown

Mesobotrys Sacc. Cotype species, *M. macroclada*, *M. fusca*.

I regard this name as a synonym of *Gonytrichum*.

Chaetopsis Grev. ex Corda. Type species, *C. wauchii*.

Main stalk of conidiophore unbranched, erect, with sterile apex, bearin generally short single or paired primary lateral branches in the lower part secondary lateral branches are also produced.

Phialides (polyphialides) terminate the lateral branches and are produce on them laterally below the septa; they are more or less cylindrical.

Phialospores more or less cylindrical, slimy, 2-celled, hyaline.

Chaetopsella v. Höhn. Type species, *C. grisea.*

I regard this name as a synonym of *Chaetopsis.*

A note on Monilochaetes

Clements & Shear (1931) cited the generic name *Monilochaetes* Harter (1916), type species *M. infuscans* Harter (loc. cit.), as a synonym of *Chaetopsis* but they did not make the new combination. According to Harter's illustrations *Monilochaetes infuscans* produces amerospores and is quite distinct from *Chaetopsis*. Clements & Shear classified *Chaetopsis* with the Amerosporae.

Two slides made by Mr E. W. Mason, through the kindness of Prof. H. J. Lam, Director of the Rijksherbarium, Leiden, have been examined. I am also grateful to Miss E. M. Wakefield, Herb. R.B.G. Kew, Dr J. Ramsbottom, Brit. Mus. (Nat. Hist.) and Prof. W. Stiles, the University, Birmingham, for permission to examine collections in their keeping.

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HYMENOPODIUM

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(With 1 Text-figure)

The generic name *Hymenopodium* Corda is based on *H. sarcopodioides* Corda. The presumed type collection has been examined and is found to be *Clasterosporium caricinum* Schw., the type species of the generic name *Clasterosporium* Schw.

Hymenopodium sarcopodioides Corda

n 1837 Corda described his genus *Hymenopodium* for his single species *I. sarcopodioides* with the following diagnoses: 'Stroma membranaceum, ffusum, tenuiter cellulosum, superficiale, primum adnatum dein liberum. porae fasciculares, erectae, septatae, clavatae: obtusae, vel fusiformes: cutae. *H. sarcopodioides.* Longitudinis pollicis dimidii, fuscum; stromate enui, cellulis minutis, vesicularibus; sporis magnis, dein deciduis, fuscis, ubdiaphanis. In caulibus et foliis putridis [Czechoslovakia].'

In 1851 Bonorden made the combination *Sporidesmium sarcopodioides.*

In 1886 Saccardo compiled Corda's species as *Clasterosporium sarco- odioides*.

In 1929 v. Höhnel† stated that '*C. hirudo* Sacc. and *C. hormiscioides* Sacc. ? Corda) must be considered the type species of *Clasterosporium* Sacc. 1880 and 1886). In these species a free mycelium is absent and when vell developed there is a cellular, superficial, ingrowing stroma present, earing short conidiophores on which conidia are borne. On the whole, hese fungi are similar to *Hymenopodium* Corda. Therefore I consider *lasterosporium* Sacc. 1880 to be identical with *Hymenopodium* Corda and is o be assigned to the Tuberculariaceae.'

Hughes (1951), relying on Corda's figure, considered that *H. sarcopodioides* ore a similarity to the fungus redescribed as *Camposporium pellucidum* Grove) Hughes. The two fungi are quite distinct, as an examination of aterial from Corda's Herbarium has so clearly shown.

Through the kindness of Prof. A. Pilát and of Miss E. M. Wakefield was enabled to examine what is probably the type collection of *Hymeno- odium sarcopodioides*. It is Herb. cryptogam. Mus. Nat. Praha, Czecho- ovakia, No. 515138 [Herb. I.M.I. (slide) 44510] and is labelled *I. sarcopodioides* by Corda. Mr E. Nelmes of Herb. R. B. G. Kew kindly lentified the substrate as comprising the leaf bases of *Carex* sp. The fungus illustrated in Fig. 1. and is *Clasterosporium caricinum*, agreeing with ollections assigned to this name in Herb. I.M.I. and identified as such the first instance by Mr E. W. Mason.

The dematiaceous superficial mycelium bears numerous lobed hypho- odia with a pale circular area, in the wall next to the host, indicating the rigin of a haustorium. Short conidiophores bear long concolorous hragmospores.

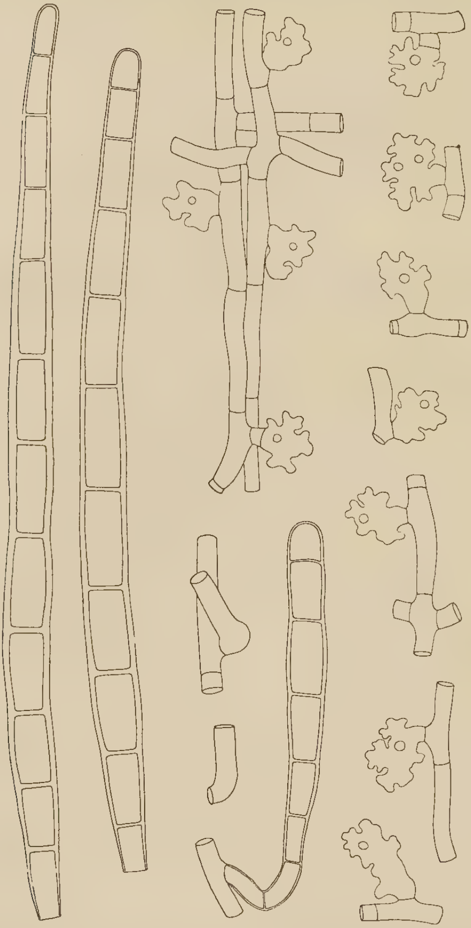

Fig. 1. *Clasterosporium caricinum*: mycelium with hyphopodia, conidiophores and conidia from the presumed type collection of *Hymenopodium sarcopodioides* Corda; × 500.

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CRYPTOSTROMA CORTICALE AND SOOTY BARK DISEASE OF SYCAMORE (*ACER PSEUDOPLATANUS*)

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(With Plates 26–27, Plate 28 in colour and 6 Text-figures)

Sooty bark is a lethal disease of *Acer pseudoplatanus*. It is characterized by wilt, die-back, bark shedding and by the production of a thick layer of brownish black, dry phialospores in the bark by a fungus invading the cambium and phloem of affected trees. It has spread continuously in and around Wanstead Park, Essex, since 1945. The fungus has been identified as the North American species *Coniosporium corticale* Ell. & Ev., which is now made the type of a new genus *Cryptostroma*, because of characters of the stroma, conidiophores and conidia.

Conclusive evidence of pathogenicity is lacking, but there is strong circumstantial evidence that the fungus is an aggressive parasite. Preliminary inoculation experiments suggest that the fungus is normally spread by air-borne spores entering through wounds and broken ends of branches. The fungus appears to be a new introduction into England.

INTRODUCTION

A hitherto unknown disease of sycamore, *Acer pseudoplatanus* L., was first observed in Essex in 1945 by Waller (1949), and has been illustrated and briefly described by Gregory, Peace and Waller (1949). The most obvious symptom is peeling of the outer layers of bark to expose a mass of dry, brownish black spores. These are produced in a cavity inside a sheet of fungus tissue consisting of a roof and floor stroma connected by stromatic columns. The affected trunk or branch dies. The fungus has now been shown to agree with the description, so far as it goes, and with the type specimen of *Coniosporium corticale* Ellis & Everhart (1889).

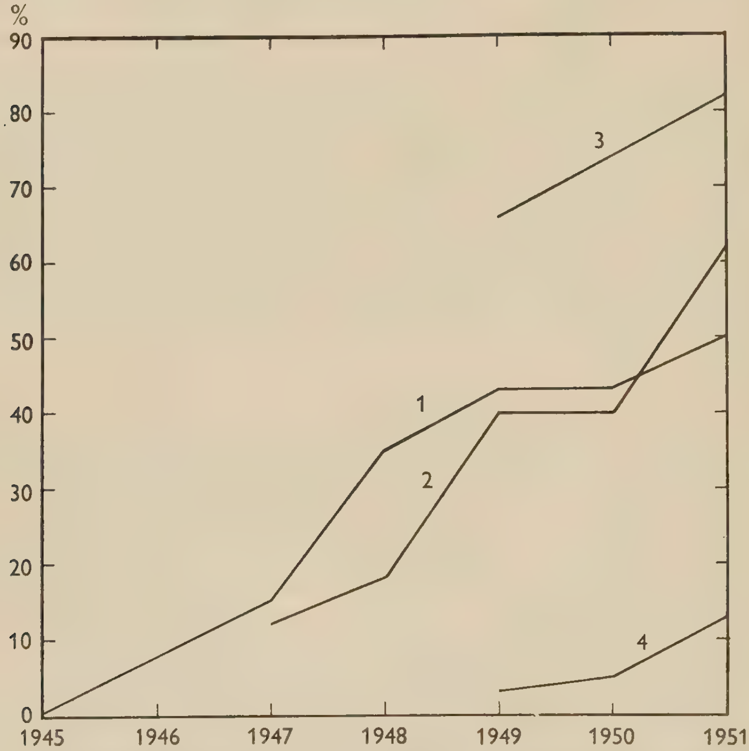
The remarkable morphological and pathological characters of the fungus have not hitherto been adequately described. Much of its biology is still obscure, but enough is now known to allow a detailed description of the fungus and of the disease in sycamore. The following account is based on our studies in Wanstead Park, Essex, from 1948 onwards.

HISTORY OF THE DISEASE

Wanstead Park is a public park owned by the Corporation of London. It is an area of about 80 acres sloping down to the bank of the River Roding, and contains an artificial lake with islands. It is largely semi-natural woodland, with a preponderance of elm, though sycamore predominates in some parts. Although surrounded on most sides by open land, it is embedded in the built-up area of Greater London and is about seven miles north-east of London Bridge.

The Park is well known to naturalists, and has been a collecting ground for several mycologists, including R. Paulson, T. Petch and Gulielma

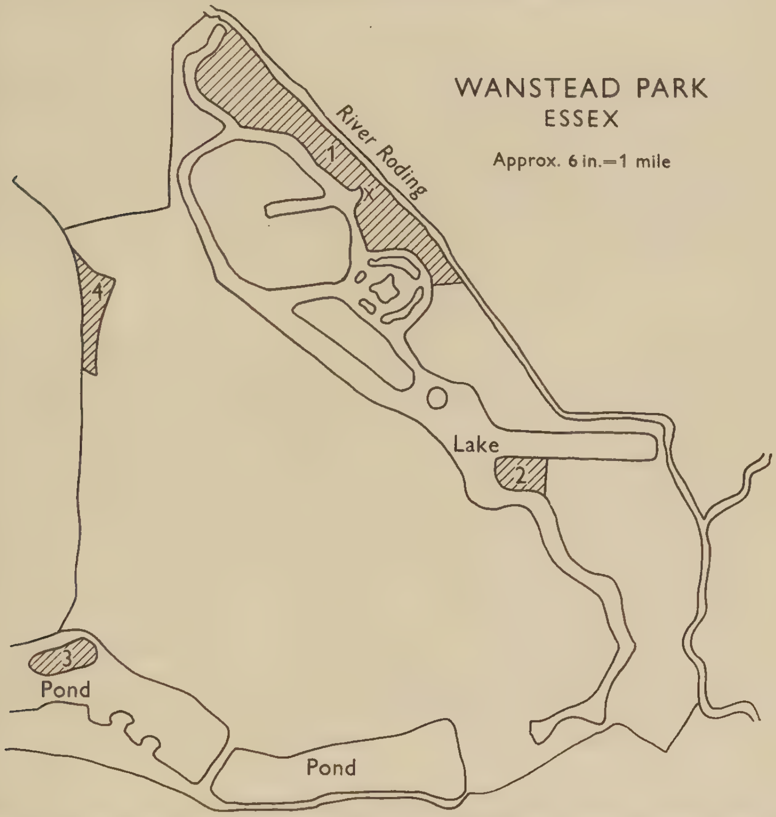
Lister. In recent years the Park has been visited several times weekly by one of us (S.W.), who observed a single dead sycamore tree 18 in. in diameter, in the autumn of 1945. The top of the tree had recently been blown off in a gale, leaving about 10 ft. of trunk standing, and the bark had been shed exposing a velvety, brownish black spore layer clothing the trunk from top to bottom. The rest of the trunk was felled later, leaving a stump on which non-viable spores could still be found in 1949. The fungus could not then be identified, and was assumed to be a saprophyte. By the middle of 1948, however, when about forty dead or dying sycamores were seen in the Park, it became obvious that an unusual disease was present, and the attention of the Forestry Commission and others was drawn to the outbreak.



Text-fig. 1. Cumulative incidence of sooty bark disease in selected areas in Wanstead Park, Essex (see Text-fig. 2). Based on surveys from 1948 to 1951.

As a result of periodic surveys it is possible to indicate the progress of the disease within the Park. A survey early in 1949 revealed sporing lesions on stumps of twenty-five trees which had been felled prior to 1948, thirty-nine dead trees which had not leafed in 1948, and another thirty-nine dead trees which had leafed freely in 1948. All trees known to be infected were felled in the spring of 1949 and a few new infections developed during the remainder of the season. During 1950 about sixty new infections were observed in the Park. Text-fig. 1 shows the cumulative percentage of rees infected in four small areas which we refer to as: (1) Roding bank, vhich includes the original focus of 1945; (2) The Point, where a second ocus developed in 1948; (3) Island in Heronry Pond; and (4) Warren Vood (Text-fig. 2).

The disease is not confined to Wanstead Park: it occurs elsewhere in the ocality, both in public grounds and in private gardens.



ext-fig. 2. Sketch map showing areas in Wanstead Park where spread of sooty bark disease has been recorded in detail (see Text-fig. 1). *X* shows where first infection was seen in 1945. Based upon the Ordnance Survey Map with the sanction of the Controller of H.M. Stationery Office.

SYMPTOMS

bservation over several years has shown that an infected tree usually hows a succession of symptoms before death, and the disease is often etectable some months before sporing lesions develop on the trunk. he sycamore shows much variation within the species, and the following ccount refers mainly to naked-eye observations of trees with thin, smooth ark.

Wilt

Wilting of leaves on one or more branches or stool shoots of sycamores in he infected area was observed during the first week of September 1949; n 1950 wilt developed much earlier and was first observed during the last week of May. The affected leaves become dry, turn greenish brown on th upper surface and curl inwards exposing the greyish green lower surface They bend just above the base of the petiole and droop, but do not abscis (Pl. 26, fig. 1). Usually only part of a tree shows wilt at one time. Whe the wilted branch is cut off a dark greenish stain can be found in the woo at a variable distance below the part showing wilt.

Die-back

Dead branches with sporing lesions can be found at any season of th year and at any height in the tree. Death of branches and sporulatio probably follow wilt, but the course from wilt to die-back has not bee elucidated in detail. Die-back of small branches in the upper part of th tree, associated with the characteristic fungus, is very common on otherwise normal-looking trees in the infected area. Not all die-back is associate with sooty bark lesions, however, and other fungi, including *Nectria cinnabarina*, are common on dead branches.

Stain

When partly affected trees are cut down a dark greenish brown to yello stain is found in the heart wood extending for long distances up and dow the trunk. The stain usually occupies only part of the cross-section (Pl. 26 fig. 2) and may contract to a dark thread towards the roots, or may expan towards the sap-wood and bark in one or more places. A sporing lesion i usually to be found where the stain meets the bark. The stain is apparentl due, not to penetration of the wood by the fungus, but to a brownis yellow discoloration of the walls or contents of lignified cells. (It may b a diffusable substance produced in infected tissue, possibly even the sam as the wilt-producing toxin.)

When the fungus has completely girdled and killed the tree the stai disappears, and the wood looks uniform pale grey. The stain appears to b a constant symptom of sooty bark, but sycamore wood is known to stai easily, and some stain arises from other causes.

Blister

After the wilt and die-back, which may pass unobserved, the nex external symptom of the disease is partial or complete failure of the tre to leaf in spring. Close examination at this stage will often show that th bark, which appears normal at first sight, is raised in blisters, usuall elongated in a vertical direction and with a wavy edge. If the tree i completely girdled and the bark uniformly raised all round, blister is no readily apparent on sight, but can be detected by touching the surface o the bark lightly with the finger tips. The surface at first resists pressur rigidly, but when the pressure is increased the outer layer of bark collapse suddenly as stromatic columns supporting the outer bark give way, and th fingers sink inwards for a millimetre or so before they are checked on th cushion formed by the masses of powdery spores within the bark. A rapi test of infection on apparently normal bark is to make a small glancing cu with a knife. Green tissue will be seen in a normal area, but the stroma an black spore mass will be exposed where there is a lesion (Pl. 28, fig. 1).

At the edge, beneath the blister, the extending lesion consists of a split heet of white mycelium partly adhering to the inner bark and partly to he outer bark, and merging into unsplit mycelium when the outer bark remains firmly attached to the inner. Away from the edge of the lesion he older part of this sheet is bluish green, and still older parts are covered with spores. Brushing or blowing to remove the spore mass from stroma where spores are actively being produced, exposes the conidiophores as a greenish grey layer (Pl. 28, fig. 2). If this in turn is scraped off with a knife or needle, the black sclerotic layer of the floor stroma is exposed. On the younger parts of the lesion where the conidiophore layer is not yet continuous, small irregular patches of stroma are visible and a mosaic pattern of white, blue, olive-green, and black can be seen.

Stripping the bark off a young stroma prevents the production of spores, hough production will continue unchecked beneath intact bark a few millimetres away.

Bark-shedding

During the months following the blister stage the affected bark slowly peels off, leaving the spore mass exposed (Pl. 27, fig. 1). For a time the outer bark is held in position by the stromatic columns joining roof and loor stroma (Text-fig. 3), but weather, helped by animals, causes the columns to break across and the bark is shed in fragments. In young esions the columns break near their bases, and are left attached to the outer bark, while older specimens usually show the column intact on the nner bark. When the bark is pulled off a sharp crackling sound is heard as the stromatic columns are snapped across, and a dense cloud of black spores floats away in the wind. The exposed spore layer is not easily wetted by rain, but remains powdery. Because of the characteristic appearance of affected trees the name 'Sooty Bark' is proposed for the disease.

Table 1. *Production of spores from mature lesions on sycamore*

Girth of tree (in.)	No. of spores per cm.^{2} of surface (million)
3	55
12	34
19	70
28	164
29	174
36	91

The number of spores produced per unit area of lesion is unusually high. Samples of bark were removed with a cork borer from six trees during the winter of 1948–9, and after suspending in a wetting liquid counts were made on a haemocytometer slide (Table 1). An infected trunk 15 ft. high and 3 ft. in girth might be expected to liberate 5×10^{13} spores, approximately the number of uredospores estimated to be produced by 200 acres of wheat moderately affected by *Puccinia graminis* (Christensen, 1942).

When the lesion has been exposed for some time the spores will have blown away and the dark floor stroma is left clothed with a close layer of stromatic columns. In time these, too, are eroded and only a roughly circular rim remains to show where each column joined the floor stroma

If the bark remains intact over the spore mass for some months, the space among the columns between floor and roof stroma becomes populated by thrips and fungus-eating beetles. The Lathrydid beetle *Enicmus brevicornis* Mann has been identified from two separate collections by Mr J. Balfour-Browne of the British Museum (Natural History). Normally the bark is shed before the beetles appear and there is no reason to suppose that insects play any large part in spreading the fungus.

The spore-layer is produced in any part of the bark, outside the cambium. In thin-barked trees it is usually just under the cork layer. More than one spore-layer may sometimes be found. Some lesions are limited to one sector of the trunk when their lateral spread is arrested, while spread continues vertically. In thin-barked trees the fungus layer tends to extend all round the tree. The lesion often becomes sunken slightly below the adjoining normal tissue and the bark is often cracked at the junction between living and dead tissue. Individuals with thick, rough bark may show only larger or smaller spore-layers scattered here and there in the bark. These trees do not usually shed the bark suddenly, but lose it over several seasons. Finally the whole thickness of bark is shed leaving a smooth, non-sporing black stroma exposed in the cambium region.

When the tree is killed the wood is weakened, perhaps through drying, and it becomes liable to damage by wind.

THE FUNGUS

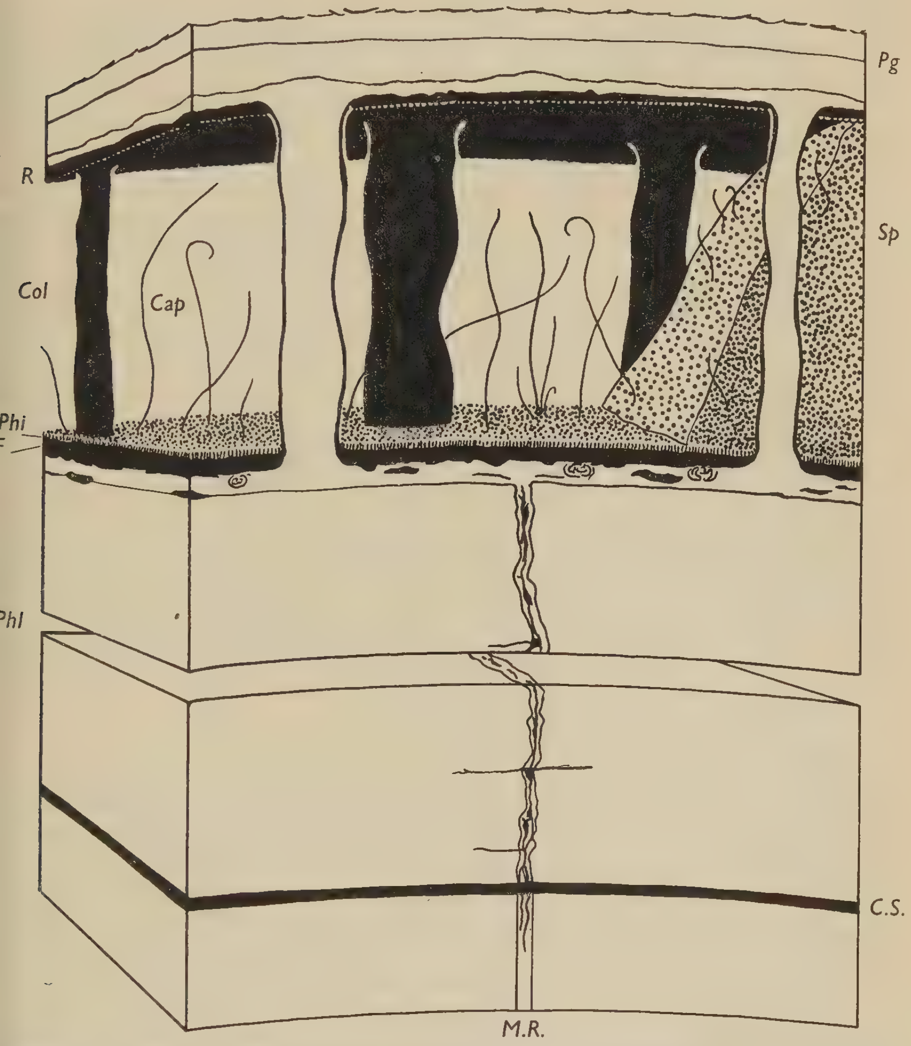
The following description of the microscopic characters is based partly on hand sections of fresh material but principally on material fixed in Carnoy's fluid, brought through chloroform to wax for the microtome, and mounted either in balsam after staining with eosin and light green, in lacto-phenol unstained, or in lacto-phenol with cotton blue.

Mycelium

Beneath a sporing lesion hyphae of the fungus are scanty in the wood; few seem to occur in the vessels but groups of irregular, septate, dark-walled hyphae penetrate into the xylem for a short distance along the medullary rays. The cambium becomes filled with a sheet of dark, contorted hyphae, mainly running vertically, and uniting with other similar hyphae which form a strong system running out into the phloem along the medullary rays. Short hyphae extend tangentially into the phloem tissue from the medullary rays and then may be compacted into thin stromatic plates. Somewhere beneath the phellem and phellogen the main sporing stroma is formed, connected to the root-like absorbing system in the cambium and medullary rays. The fungus is essentially a phloem and cambium invader.

Stroma

Before spores are formed the stroma is a sheet of white mycelium, and beyond the edge of a sporing stroma white flecks of mycelium in the bark are visible to the naked eye. In a typical thin-barked tree the flecks join to form a continuous thin sheet of fungus pseudo-parenchyma (plectenchyma), consisting of irregularly rounded, thin-walled cells with contents staining deeply with cotton blue. In the older part of the plectenchyma



Text-fig. 3. Diagram showing position of main structures of *Cryptostroma corticale* in relation to a thin-barked specimen of sycamore *Acer pseudoplatanus*. × 50 approx. *Pg*, phellogen; *R*, roof stroma; *Col*, columns; *Cap*, capillitium; *Sp*, spore mass; *Phi*, phialide layer; *F*, floor stroma; *Phl*, phloem; *C.S.* cambial stroma; *M.R.* medullary ray.

a split develops near the middle of the sheet and parallel to its surface. A short distance above and below the split, the walls of groups of cells become thickened and dark in colour. This change occurs in patches which subsequently join to form the continuous roof stroma and the continuous floor stroma shown diagrammatically in Text-fig. 3. Each stroma continues for a time to be lined on the side facing the cavity between them by a layer of thin-walled cells staining in cotton blue. Those on the roof stroma degenerate, while those on the floor give rise to the conidiophore layer.

The mode of origin of the stromatic columns is uncertain, but apparently tangential cleavage of the plectenchymatous layer is incomplete, and a few islands of tissue are left joining floor and roof. These elongate at the base as floor and roof separate and become covered in a sclerotic outer layer which at first also bears an external layer of thin-walled cells. Whether the columns themselves push up the roof stroma as a result of basal growth, or whether they are drawn out by external forces is not clear. The spore mass itself is looser in texture than would be expected had it been responsible for the separation of the two layers. Apparently separation keeps step with spore formation.

The roof stroma consists of three layers. The lower layer is fragile with colourless, more or less iso-diametric cells which soon disappear leaving the dark middle layer of inflated cells (Text-fig. 4) forming the ceiling of the spore chamber. The outer layer of the roof stroma consists of radially elongated, thin-walled cells, at first staining with cotton blue, later becoming evacuated and often collapsing to form a narrow disorganized zone.

The floor stroma also has three layers. The lower one is thin-walled, has hyphae in the disorganized phloem of the host and is connected to the conducting strands in the medullary rays. The outer cells of this layer become sclerotic and form the black plate underlying the closely packed conidiophore layer. This dark plate and the colourless layer beneath it are continuous with the dark wall and hyaline core of the stromatic pillars, which in turn merge into the corresponding layers of the roof stroma (Text-fig. 4). Occasionally knots of hyphae reminiscent of perithecial initials occur in the lower zone of the floor stroma, but no further development has been observed.

In a rapidly progressing blister stage the entire outer bark below the phellem may be lifted a millimetre or more radially outwards from the trunk. This may extend from ground level to the top of the main trunk and up larger branches. Below the outer bark a series of concentric cylindrical zones can be distinguished. The outermost is the continuous cylinder of the roof stroma. Below this is a space about a millimetre wide packed with dry spores and traversed by black stromatic columns (about fifty to the square centimetre) supporting the roof stroma, and continuous in structure with the roof stroma and the floor stroma which they join together. The floor stroma itself forms another continuous cylinder of fungus tissue. Below this is the disorganized phloem merging into the more normal phloem. A black stromatic layer is formed in the cambium.

Often the lesion at first extends only partly round the trunk, as in the photograph published by Gregory *et al.* (1949).

Trees with thick bark may show numerous small separate sheets of stromatic tissue an inch to a few inches in diameter. The main features of roof and floor stroma joined by pillars and enclosing a powdery spore mass occur also in the small lesions.

Conidiophores

At maturity the floor stroma is carpeted with a continuous layer of short, ect, closely packed, unbranched conidiophores. They are absent from the rfaces of the columns and roof stroma. Each conidiophore consists of om three to five more cells, the lower cells somewhat dark-walled and the stal ones hyaline (Text-fig. 5). The wall of the spore is difficult to see ithin the phialide, and Text-fig. 6 is a diagrammatic interpretation of ext-fig. 5.

Conidia

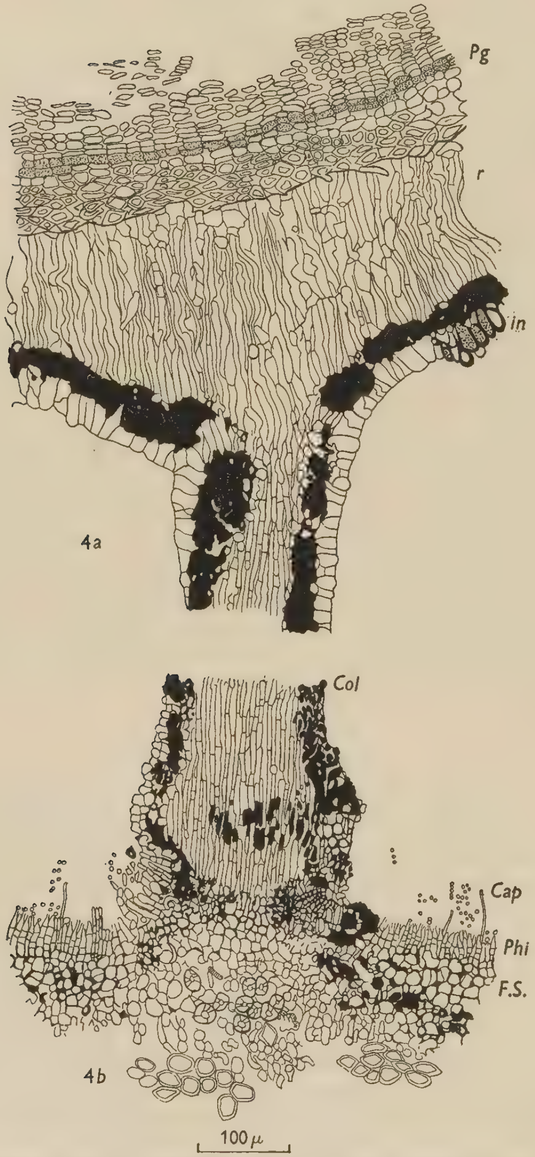
When first extruded the endogenous conidia are yellowish with a hyaline all, and stain with cotton blue. They measure $5{\cdot}4 \times 3{\cdot}9\,\mu$ (4–$6{\cdot}5 \times 3{\cdot}5$–$4\,\mu$) ıd are typically ovoid, but sometimes somewhat rectangular as a result lateral pressure between conidia standing on adjacent conidiophores. ightly older conidia are brown-walled with very transparent contents hich do not stain with cotton blue. The spore wall is smooth, even in ectron micrographs (Gregory & Nixon, 1951, pl. 31, fig. 9). The spores lhere in fragile chains, the youngest being nearest to the tip of the hialide. In lacto-phenol and most other mountants the chains fall apart, ıt chains of up to twenty or thirty spores can be found in material ırefully mounted after wetting with alcohol. The conidia are dry phialo- ores, and are easily separated by air currents. No slime spore stage has een found associated with this fungus in nature. In some microtome eparations stratification of the spore mass has been observed, darker ıd denser layers alternating with lighter ones, suggesting that season or eather has affected spore production.

Capillitium

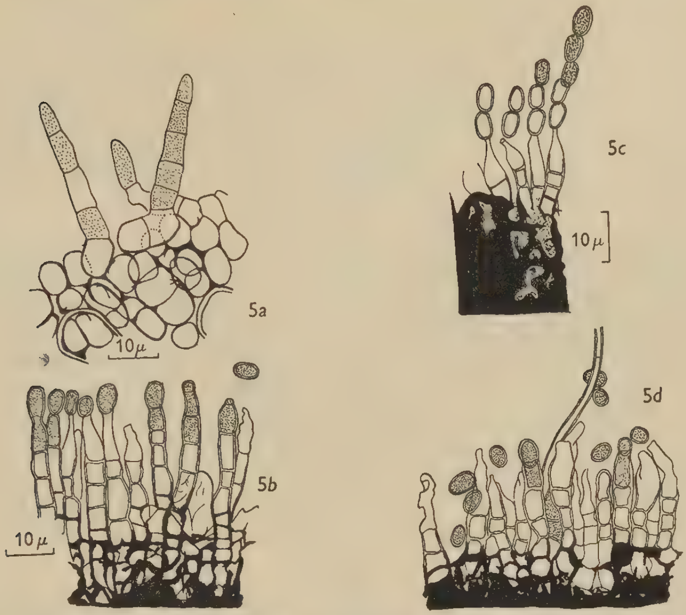
When the outer bark falls off most of the spore mass adheres to the floor roma, and will stay on the vertical or even inverted surface of the trunk or anch for weeks during slow removal by wind. This is possible because e spore mass is held in position by a system of threads attached to the oor stroma (Text-fig. 3). These threads arise singly or in tufts in the nidiophore layer, they are up to 1 mm. long, unbranched, 2–$3\,\mu$ diam. base, but only $1{\cdot}5\,\mu$ diam. for most of their length. They are slightly aved, sparingly septate, with protoplasmic contents persisting, and ımber up to about 100,000 per cm.^{2} of floor stroma. The walls of the ıreads are sticky and are always coated with spores, some of which remain tached even after heating in lacto-phenol. The spore-coated threads can ısily be seen when a freshly exposed spore mass is examined with a hand ns.

Cultures

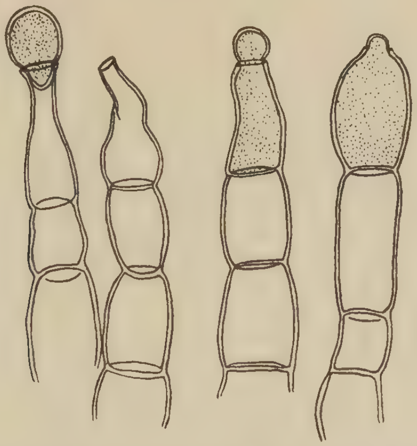
Fresh conidia germinate freely, but those from old specimens often do ɔt. The fungus grows readily on ordinary culture media, but fails to oduce the characteristic phialospores and stroma. On Czapek-Dox and ɔtato-dextrose agars a sparse whitish to buff aerial mycelium is formed, ıd the immersed mycelium colours the medium Russet to Mars Brown.



Text-fig. 4. *Cryptostroma corticale.* Transverse section through stroma in bark (stromatic colum shown with about half its length omitted to save space). *Pg*, phellogen; *r*, radially elongate cells of roof stroma; *in*, inflated dark cells of roof stroma; *Col*, stromatic columns joinin floor and roof stroma; *Cap*, capillitium attached to floor stroma; *Phi*, phialide layer coverin floor stroma; *F.S.* floor stroma.



Text-fig. 5. *Cryptostroma corticale.* Stages in development of conidiophores. *a*, young conidiophores from white layer near edge of stroma; *b*, older conidiophores with stages in spore formation; *c*, conidiophores with spores in chains; *d*, old conidiophores, with capillitium attached to floor stroma.



Text-fig. 6. Diagrammatic interpretation of Text-fig. 5*b* showing flask-shaped terminal phialides, one of which is empty and has collapsed, and stages in extrusion of endospores.

IDENTITY OF THE FUNGUS

In November 1948, specimens were examined at the Ministry of Agriculture and Fisheries' Plant Pathology Laboratory, by Dr F. Joan Moore, who suggested that *Coniosporium corticale* Ell. & Everh. might be considered as a name for the fungus. The brief diagnosis given by Ellis and Everhart (1889) is as follows:

'*Coniosporium corticale* n.sp.

In bark of maple logs. London. Canada. Prof. J. Dearness, No. 2. Forms a brownish-black dusty stratum between the lamina of the bark. Conidia globose 3–5 μ in diameter, or elliptical or ovate-elliptical 4½–5 × 3–4 μ. The globose conidia comparatively few. This must come near *C. aterrimum* Cda., but we think it different, though we have no specimen of that species.'

The few characters given in this description agreed with the fungus on *Acer pseudoplatanus*, but omitted reference to some of the most conspicuous characters seen in our material, the floor and roof stroma and the phialospore layer. However, in October 1950, through the kindness of Dr D. P. Rogers, the type specimen of *Coniosporium corticale* in the Ellis Collection was sent to the Commonwealth Mycological Institute on loan from the New York Botanical Garden. The label on the packet reads 'Type. Fungi of Ontario. No. 2. *Coniosporium corticale* E. & E. In maple bark. London, Apr. '89. leg. J. Dearness.' The specimen was examined by Dr M. B. Ellis who reported: 'Both from its macroscopic appearance and from examination of slides it seems probable that this is the same species as the sycamore fungus.'

When examined by us the type specimen showed the features characteristic of the sycamore fungus, typical roof stroma with inflated cells, and sclerotic pillars joining it to the floor stroma which was carpeted with conidiophores ending in phialides, producing brown ovoid conidia 5 × 3·6 μ (4–6 × 3–4 μ). Microscopic preparations of the phialide layer from this specimen (Herb. I.M.I. 43411) appear identical with fresh specimens from Wanstead.

Specimens of the fungus were also distributed as exsiccata in Ellis and Everhart's *North American Fungi*, Second Series, No. 2796, as '*Coniosporium corticola*, E. & E. In maple bark, London, Canada, J. Dearness, May 1889'. (The spelling '*corticola*' is evidently a copying error.) Specimens of this series have been examined from the following collections: Herbarium of the New York Botanical Garden, Herbarium of the Royal Botanic Gardens, Kew; and Herbarium of the British Museum (Natural History). The Kew specimen includes both roof stroma and floor stroma with typical phialides, spores and columns. The British Museum specimen consists of outer bark only, and shows the roof stroma, eroded tops of columns, and spores, but no phialide layer. Mrs F. L. Balfour-Browne reported 'Your fungus is identical with it as far as I can see'. Another specimen examined in this herbarium is 'Ellis & Everhart. Fungi Columbiani, 989. *Goniosporium corticale* E.& E.... Jan. 1896. J. Dearness.'

The Canadian collections are from trees with thick bark and appear macroscopically very similar to our own collections from thick-barked sycamores.

In a letter to one of us, dated 28 November 1950, Dr John Dearness kindly gave the following information. 'I made the type collection on 4-foot long cuttings of a load of maple bought from a farmer living about 10 miles from London, Ont. The trees would be about 8–12 inches in diameter, probably felled in the winter of 1888 or 1887 and delivered to me for firewood in 1889. The bark detached easily. I collected it in quantity for exsiccat Fun. Col. and N.A.F., 100 specimens for each.... The circumstances and conditions prevented my forming an opinion *re* parasitism. Bartholemew, to whom I sent the F. Cols., asked me to compare the material with *Goniosporium.* It (Gm.) is different.' Dr Dearness also sent a specimen from his Collection No. 482, May 1889, London, Ontario, on a species of *Acer* not determined, but with the note that the species used for firewood is *A. saccharinum* L. (*A. saccharum* Marsh). This specimen contains both floor and roof stroma with bases of columns. Microscopic examination of sections shows typical phialides and catenulate conidia. The roof stroma has dark inflated cells, and a well-developed zone of thin-walled, radially elongated cells on the outside.

Little has been heard of *Coniosporium corticale* since 1889. Dr I. L. Conners tells us that the Herbarium of the Division of Botany and Plant Pathology, Ottawa, contains, besides a specimen of Ellis and Everhart's exsiccata No. 2766, a second specimen of somewhat later date: 'Canadian Fungi 49, on *Acer saccharinum* L. collected at (or near) London, Ontario, Canada, Dec. '95 (J. Dearness).' On the packet is the following note in Dr Dearness's handwriting. 'This species, described first from Canadian specimens ...is not parasitic but hastens decay. It is one of the Dematici—black moulds, and is common here on fallen timber in the first or at latest second year after it falls.' Dr Conners adds that 'the host is almost certain to be *A. saccharum*, not *A. saccharinum*...there having been confusion for a period concerning the correct name to the hard or sugar maple'. The fungus has apparently not been collected in Canada since 1895.

In the U.S.A. the fungus has been reported by Towey, Sweany and Huron (1932) as producing severe bronchial asthma in workers in Michigan inhaling spores from dust in maple logs. They figure a cross-section of a maple log showing the black dust beneath the cork layer, and also a photomicrograph of spores. Spores were sent for cultural studies to Dr F. L. Stevens who reported mycelial growth on various media but no spore production, and that 'microtome sections of the [presumably outer] bark in which the spores were found show numerous spores and abundant mycelium, but...no spores have been found attached'. Specimens were also submitted to Dr R. R. Sayers who reported that the organism had been tentatively classified as the conidial stage of some species of *Nummularia*, and that Dr C. Thom had stated that it is known as *Coniosporium corticola.* Other specimens were sent to Dr C. Audrey Richards who confirmed that the fungus had been identified as *C. corticale* E. & E. adding: 'This fungus has also been found recently on dying maples, hickories and basswoods [*Tilia* spp.] in some virgin forest north of Fond du Lac, Wisconsin. It is one of the Fungi Imperfecti, and is probably the imperfect stage of another fungus which might be causing the disease of the trees.' No other records have been traced, and the fungus has apparently never been reported outside the area Wisconsin, Michigan and Southern Ontario. Only in Wisconsin is there any indication that the fungus might be the cause of a tree disease.

Possibly the fungus is known elsewhere under another name, and its relationship to a number of similar fungi has therefore been considered.

Canker stain of *Platanus* spp. in the eastern United States caused by a species of *Endoconidiophora* resembling *E. fimbriata* (E. & Halest.) Davidson has been described by Walter (1946). The fungus has not yet been named or described in detail, but apparently it produces spores only on the exposed wood, not within the bark, and is transmitted only by pruning operations. The spores of our sycamore fungus are certainly endoconidia, but are produced within flask-shaped phialides at most two spores at a time, one of which is being extruded while the other, probably still a naked protoplasmic mass, is being formed at the base of the phialide. *Platanus* in Wanstead Park is apparently not attacked by the fungus.

Trichosporium vesiculosum Butler has been described causing a wilt of *Casuarina equisetifolia* in Southern India by Marudarajan, Ramakrishnan and Soumini (1950). Specimens and cultures of this fungus sent to us from Madras by Prof. T. S. Sadasivan resembled the sycamore disease in producing blister lesions and very similar spores under the bark, but the stromata, roof, floor and columns, as well as the phialide layer, were lacking.

Torula exitiosa de Seynes, from the short description compiled in Saccardo, might be the sycamore fungus, but it produces its spores in the cortical layers of chestnut roots. We have not examined specimens of this fungus.

Catenularia atra (Corda) Sacc. The genus *Catenularia* Grove has spores formed from an open growing point within a cup or expanded mouth, not in a flask with a contracted mouth as in our fungus (Mason, 1941, pp. 120, 122). *Psilonia atra* Corda (*Icones*, **4**, 27) may not belong to the genus *Catenularia* to which it was transferred by Saccardo. Its ornate spores are produced in the bark of oak, apparently in basipetal chains from long narrow conidiophores to judge from Corda's illustration and description. The spores of our fungus, as already mentioned, are quite smooth. *Gymnosporium aterrimum* Corda (*Icones*, **2**, 1838) (*Coniosporium aterrimum* (Corda) Sacc.), referred to as a similar fungus in Ellis and Everhart's description of *C. corticale*, occurs on decorticated rotting wood of *Salix* and other trees, not in the bark. We have not seen specimens, but Corda's figure appears quite unlike our fungus.

Nummularia sp. Dr C. Thom suggested (see p. 591) that *Coniosporium corticale* might be the conidial stage of a *Nummularia*. This genus was distinguished by Tulasne (1863, **2**, 40 and pl. V. fig. 14) as having a bipartite stroma in the cortex of trees, with abundant conidia between the layers, which escape as a pure white powder. Miller (1928, p. 323) doubts whether conidia are in fact produced between the ento- and ecto-stromata as shown by Tulasne. The conidia are apparently dry radula-spores produced on branched conidiophores. The resemblance to the sycamore fungus is slight.

Cephalosporium diospyri Crandall causes wilt of persimmon, *Diospyros virginiana* in the eastern United States. Unlike most species in the genus *Cephalosporium* it has dry spores which are produced abundantly in the cambial region and extruded in red blisters where the bark is forced away from the wood (Crandall & Baker, 1950). Microscopic characters are evidently unlike *Coniosporium corticale.*

Cerastomella pini Münch (1907), described as causing blue rotting of pine, has a stroma between wood and bast, or within the bark, essentially similar in structure to that of the sycamore fungus, with an upper and lower fungus layer separated by stromatic columns ('sclerotia') growing at their base till they reach a height of about ½ cm. These 'sclerotia' are said to be double the length of the perithecia and normal conidiophores (which appear to be of the *Trichosporium* type), and thus allow room for two layers of fruit bodies, one from the bast and one from the wood. These can develop and sporulate in the damp air of the protecting cavity, and are liberated by shedding of the bark or by insects. No perithecial stage is known in the sycamore fungus, however, and the analogy of the stroma does not justify putting the fungus in the genus *Ceratostomella*.

The genus *Coniosporium* Link, according to Mason (1933, pp. 15–16) who examined type material, is founded on a specimen with multi-septate conidia, resembling *Sporodesmium peziza* Cooke & Ell., and is therefore not available for the numerous species with 1-celled spores compiled under that genus by Saccardo. Further the species regarded by Saccardo as typical of the genus, *Coniosporium arundinis* (now better known as *Papularia sphaerosperma* (Pers. ex Fr.) Höhnel), is quite unlike our fungus on sycamore and the Canadian specimens on which Ellis and Everhart erected the species *Coniosporium corticale*, both in its mode of spore formation and in the arrangement of the conidiophores. It is clear that the fungus with which we are dealing cannot remain in the genus *Coniosporium*, and another home must be found for it. The first step is to decide whether it belongs to the Melanconiaceae, the Dematiaceae or the Tuberculariaceae.

If the spore-bearing structure is regarded as an enlarged erumpent acervulus, with short simple conidiophores arising from a basal stroma, it would be classified in the Melanconiaceae-phaeosporae near the genus *Trullula*. This genus, however, has exogenous spores with the youngest at the end of the chain. Our fungus does not fit well into the Melanconiaceae where the acervuli are usually horny or gelatinous and the spores are slime spores—'No Coelomycete is known to produce dry spores' (Wakefield & Bisby, 1941, p. 51). Neither does it fit well into the Tuberculariaceae where the sporodochia are superficial and typically have long conidiophores. If classified in this group it would go near *Sphaeromyces* or *Exosporina*. It is most convenient to treat the fungus as a hyphomycete, as Ellis and Everhart themselves did. It would then be classified in the Moniliales, Dematiaceae, Amerosporae, and in artificial keys will appear near *Torula*, *Chalara*, *Thielaviopsis*, *Chalaropsis* and *Columnophora*. None of these genera can accommodate the fungus, and it is therefore proposed to erect a new genus of the Dematiaceae for *Coniosporium corticale* Ellis and Everhart.

CRYPTOSTROMA gen.nov.

Stromata immersa, tanquam ex pavimento cum camera stromaticis juncto columnis constantia; conidiophorae breves, phialidibus ad apicem praeditae, stroma inferius strato ntegentes continuo; conidia fusca, endogena, sicca, phialidibus velut catenae emissa, patium inter pavimentum et cameram complentia.

Stroma immersed, consisting of floor and roof connected by stromatic columns; conidiophores short, ending in phialides, forming a continuous ayer covering the floor stroma; conidia brown, endogenous, dry, produced from phialides in chains, filling space between roof and floor. The name is from the Greek κρύπτη, a covered place, vault or crypt, with reference to the roof and columns.

Type species: *Cryptostroma corticale* (Ell. & Everh.) n.comb.

Cryptostroma corticale (Ell. & Everh.) n.comb. emend.

Stromata separate or in continuous sheets, forming cavities in the bark; *floor stroma* on inner bark, black, smooth; bearing rounded, black, stromatic columns up to 1 mm. long by 0·3 mm. diameter, usually persisting after shedding of outer bark; *roof stroma* black, typically with inflated sclerotic cells, shed at maturity with the outer bark to expose spore mass; *conidiophores*, three to five cells tapering upwards, 20–30 × 3–6 μ, forming a greenish grey layer over the floor stroma, straight, unbranched, hyaline, becoming sclerotic at base, terminal cell a flask-shaped phialide; *conidia* ovoid (or rectangular from mutual pressure), 5·4 × 3·9 μ (4–6 × 3·5–4 μ),* smooth, dry, walls thick, light brown (hyaline when young), brownish black in the mass, in fragile chains, sometimes adhering laterally in columnar masses; capillitium of unbranched threads, 1·5 μ diameter, attached to floor stroma.

In bark of fallen trees of *Acer saccharinum* (?) L. in London, Ontario, Canada (J. Dearness, 1889); and in 'sooty bark' disease of *A. pseudoplatanus* L. in Wanstead Park, London, England.

We have deposited typical specimens of *Cryptostroma corticale* from Wanstead Park in the Herbarium of the Royal Botanic Gardens, Kew.

It is remarkable that the characteristic stroma of this fungus, which is widely distributed in exsiccata from Dearness's collection, should not have been observed before. However, if many of the specimens in Herbaria consist only of outer bark the phialide layer would be missing, and the tops of the stromatic columns would be inconspicuous. There is nothing in the original description of the species, for example, to indicate that Ellis and Everhart saw either conidiophores, stroma or columns.

DISCUSSION

Proof of pathogenicity must wait for critical inoculation experiments with pure cultures of the fungus. However, there is circumstantial evidence that *C. corticale* is an active pathogen.

Acer pseudoplanatus is normally a hardy species, tolerating city conditions well, growing quickly when planted as a wind-break in exposed places, and subject to few diseases except leafspot (*Rhytisma acerinum*). Some explanation must therefore be found for the fact that hundreds of trees have died in the Wanstead area, and the simultaneous appearance of a conspicuous but hitherto unknown fungus on the dying trees is nearly conclusive. Further, death of the tree does not precede infection but appears to go step by step with the spread of the fungus, and lateral shoots will grow normally, a few inches to one side of a sporing lesion on the trunk.

Inoculations with fresh spores taken direct from young lesions on trees at

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* Not 3 × 2 μ as stated previously (Gregory, Peace & Waller, 1949) through my error.—P. H. G.

Wanstead on to the freshly cut ends of branches have reproduced the disease in typical form in about ten months.

The obvious mode of spread of the fungus is by wind-blown spores. Unlike the spores of most other air-borne pathogens, the spores of *Cryptostroma corticale* are small, and in this they resemble the spores of *Stereum purpureum* and some other fungi infecting through broken branches, which, as pointed out by Brooks and Moore (1923), are small enough to be drawn into exposed vessels by capillarity when wetted by rain. Our inoculation experiments support this hypothesis. Snapping of branches by wind, falling of adjacent trees and other causes appear to lead to stub-infection and die-back. Cutting hearts and initials on trunks by members of the public might be expected to provide entry points, but seem of little importance, perhaps because very small spores are not efficiently deposited on wide cylinders (Gregory, 1950). At Wanstead most infections seem to begin high in the tree on small branches. The incidence of the disease on the islands, to which the public has no access, is very high. In a new area the disease tends to appear first in places most exposed to wind.

No control measures can yet be recommended as the result of experiment. A common-sense precaution is to search for diseased trees carefully, and to cut down and burn on the site as soon as possible all diseased trees and suspects. Although the number of spores produced by a diseased tree is very great, the number of visible new infections resulting per infected tree per year is evidently not large, and there is hope that by steadily reducing the inoculum the number of new infections will fall below replacement rate. There is evidence that cutting out infected parts may prevent spread to the whole tree.

In Britain, so far as is known, *Cryptostroma corticale* is still confined to the Lower Thames Valley, and its incidence is highest in the Lower Roding Valley. Near the centre of infection in Wanstead Park from 15 to 20 % of mature trees and saplings are being killed each year, a rate which agrees well with the fact that the fungus has been observed only recently in this area.

The tree on which the fungus was first observed in 1945 may possibly not be the earliest occurrence in England, and any explanation of how this tree became infected must remain highly speculative unless fresh and unexpected sources of information are discovered.

Two unlikely hypotheses presuppose that the fungus is a widely distributed, but hitherto overlooked, saprophyte which has either: (1) produced a mutant pathogenic for *Acer pseudoplatanus*; or (2) encountered a local mutant population of susceptible hosts. There are verbal reports of the occurrence of 'sooty' trees in Wanstead Park for many years, believed locally to be due to deposition of London smoke and probably having no connexion with the sooty bark disease of sycamore. The disease was not reported by Miss G. Lister in her survey of the flora of Wanstead Park (Lister, 1942). The most probable explanation of its distribution is that the fungus has recently been introduced from North America, and is now spreading from a centre where it is well established. The possibility that the fungus was imported on timber to the extensive Dockside timber yards where the River Roding joins the Thames is a reasonable speculation.

Possibly we are witnessing another example of the phenomenon, already familiar in plant pathology, of a fungus which is relatively harmless on the wild hosts of its native continent crossing an ocean and devastating allied host species with which it has not established a balanced relationship.

In addition to those workers whose help has been mentioned in the text, we wish to thank Miss L. Cunow for histological preparations, Mr T. R. Peace, Forest Pathologist to the Forestry Commission, for his help in obtaining specimens, to Mr V. Stansfield for the photographs, and to Mr D. H. Boalch for the Latin diagnosis.

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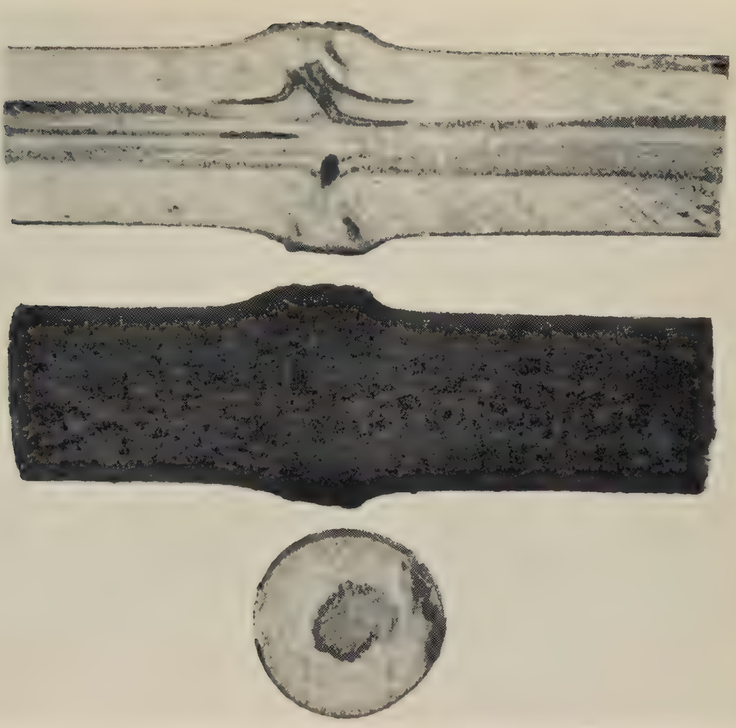


Fig. 2.

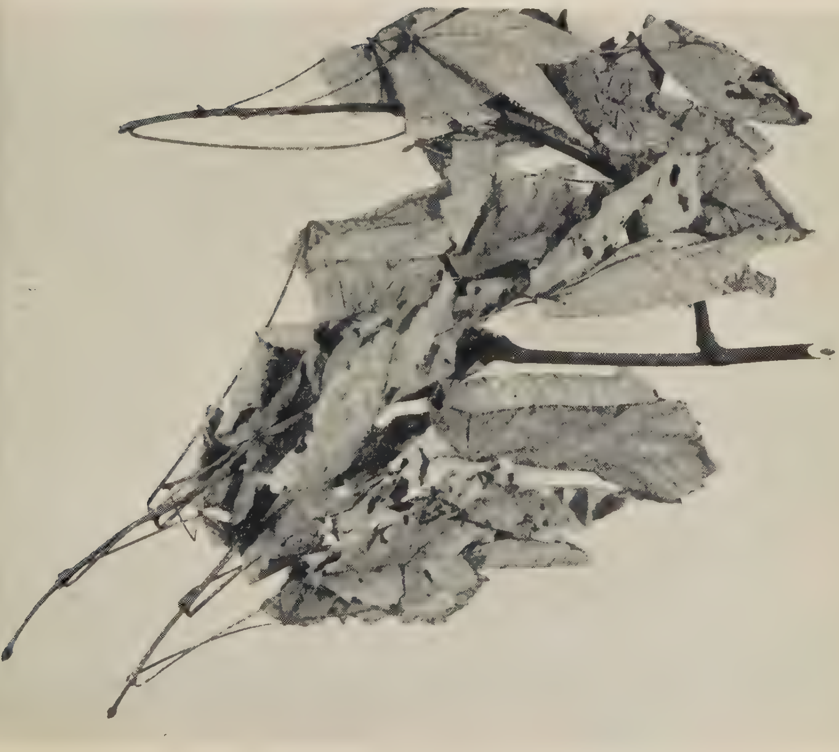
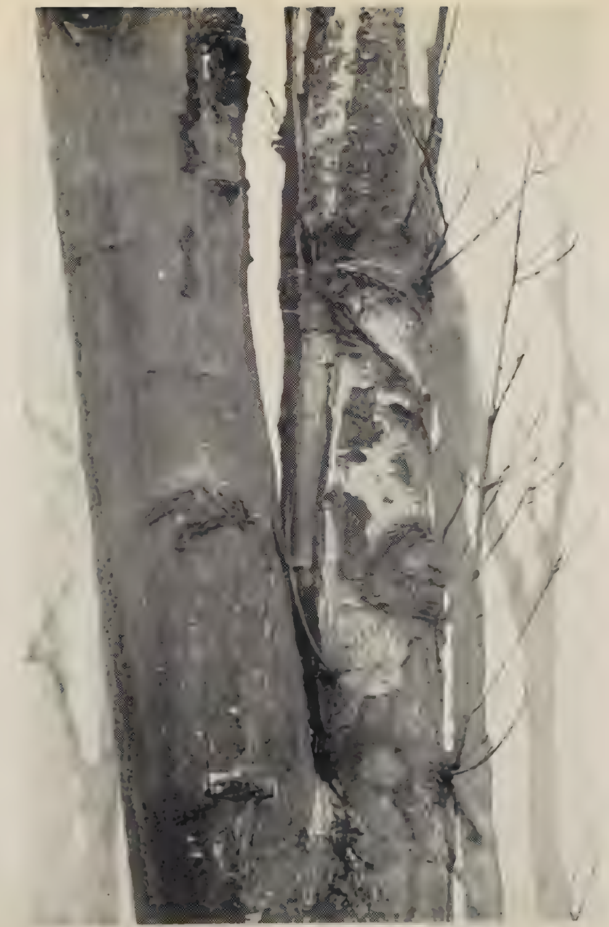


Fig. 1.



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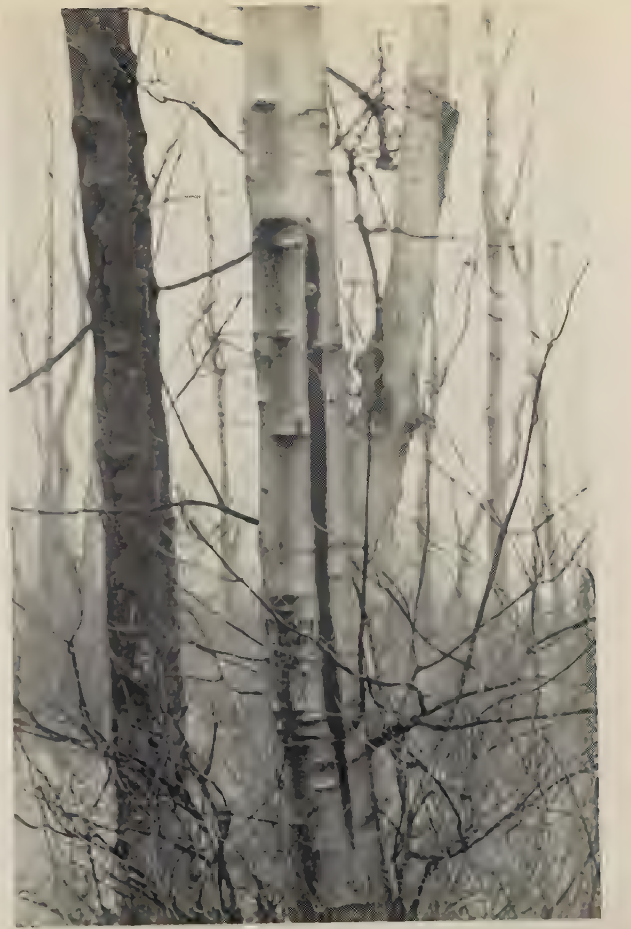

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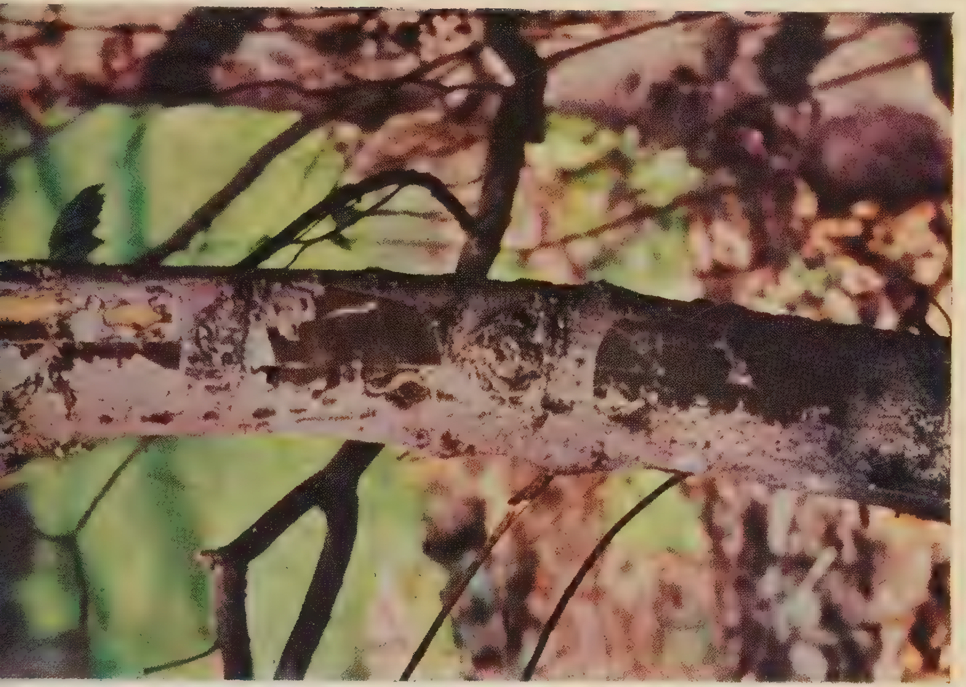

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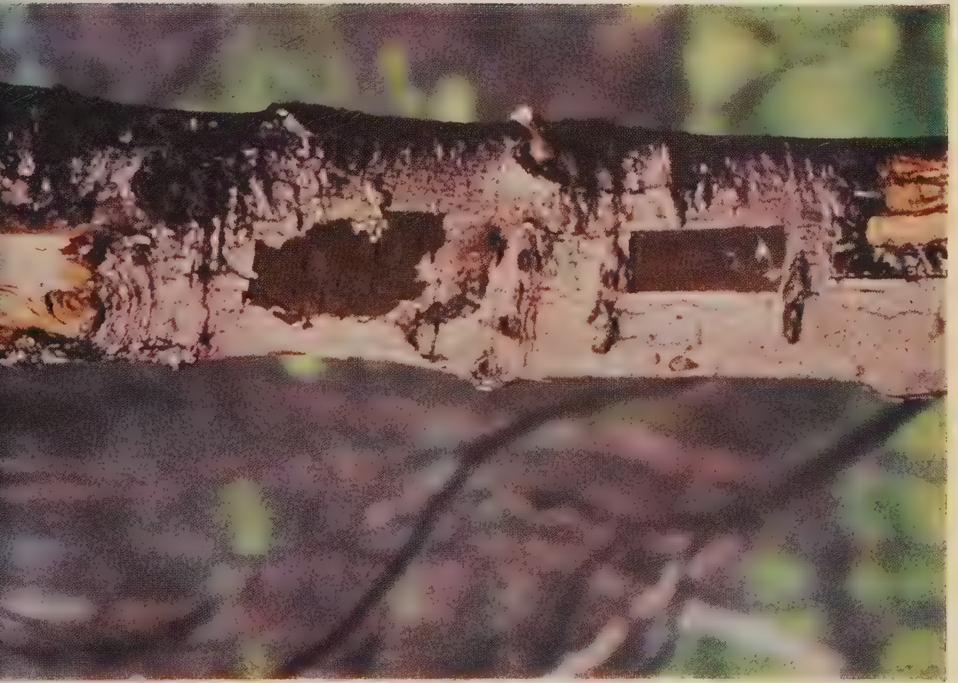

Fig. 1

EXPLANATIONS OF PLATES 26–28

PLATE 26

Fig. 1. Wilt of *Acer pseudoplatanus* and stain in pith, associated with sooty bark disease. Wanstead, October 1949.

Fig. 2. Stain in wood associated with sooty bark disease. × ½. Wanstead, October 1949.

PLATE 27

Fig. 1. Sooty bark disease of *Acer pseudoplatanus*. Blister stage on right-hand trunk showing outer bark peeling off exposing spore mass of *Cryptostroma corticale*. The left-hand trunk has shed all its bark, most spores are also gone leaving the floor stroma exposed. Wanstead, January 1949.

Fig. 2. Streak type of lesion where invasion by the fungus is limited to one sector of the trunk. Wanstead, January 1949.

PLATE 28 (in colour)

Fig. 1. Apparently normal trunk of *Acer pseudoplatanus* girdled with blister stage of sooty bark disease. Spore mass of *Cryptostroma corticale* exposed by removing bark with point of knife. Wanstead, April 1950.

Fig. 2. Stages in development of stroma of *C. corticale* exposed by pulling outer bark from immature sooty bark lesion. Wanstead, April 1950.

(*Accepted for publication* 17 *March* 1951)

TWO NEW PREDACIOUS HYPHOMYCETES

By C. L. DUDDINGTON

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(With 5 Text-figures)

An account is given of two predacious hyphomycetes, *Arthrobotrys robusta* n.sp. and *Trichothecium cystosporium* n.sp., both of which capture nematode worms by means of adhesive networks.

Arthrobotrys robusta sp.nov.

Mycelium hyphis rectis, septatis, 2–7 μ crassis, parce ramosis, reticula tenacia qua vermiculos nematodeos capiunt evolventibus; tuber infectionis per integumentun vermiculi e quo hyphae edentes excrescunt intrudentibus. Conidia hyalina, oblonga pyriformia, uniseptata, 18–27 μ longa, 8–12 μ crassa, ad apices hypharum fertilium erectarum, saepe ramosarum, 150–300 μ altos aggregata.

Vermiculos nematodeos capiens consumensque in ligno putrido prope Micklehan Surrey, October 1948.

This fungus was obtained from a collection of rotting wood fron a beech wood near Mickleham, Surrey. When small portions of the materia were placed on plates of sterile maize-meal agar, the fungus was founc attacking the nematodes that wandered out from the wood to the surfac of the medium.

The mycelium consisted of straight, septate hyphae, 2–7 μ in diametei containing highly vacuolated cytoplasm. At intervals, short latera branches were produced which formed three-dimensional networks, b curling back and anastomosing with the main hypha or with other simila outgrowths, the individual loops being mostly 20–60 μ in outside diametei These networks resembled those formed by *A. oligospora* Fres., and, as i usual in these reticulate hyphomycetes, the cytoplasm of the cells composin the loops contained large vacuoles (Fig. 1 *a*, *b*).

Nematodes were captured by adhesion to the networks and held fast i spite of struggles to get away. They died soon after being captured. Th mechanism was highly efficient; nematodes were caught in large number and some of them were as much as a millimetre long. When a nematod had become moribund after capture, its integument was pierced by a outgrowth from the loop, forming a subspherical infection bulb within th body of the animal, from which trophic hyphae grew and spread througl out its carcass, absorbing the contents (Fig. 1 *a*). The trophic hyphae wer usually about 4 μ wide and, in their later stages at least, were septat Eventually only the empty integument of the nematode remained, fille with trophic hyphae.

Spores were formed earlier and in greater profusion than is usual in th predacious hyphomycetes. Conidiophores rose erect to a height of 150 300 μ. These were often branched, sometimes more than once, wit a compact group of conidia at the apex of each branch (Fig. 2 *f*). Th onidia were oblong-pyriform, measuring 18–27 × 8–12 μ, and were divided y a transverse septum into two cells, usually of nearly equal length Fig. 2*g–l*). They germinated readily on sterile agar, normally by a germ ube growing from the proximal cell, and the germ tube was usually omewhat swollen at the point of exit (Fig. 2*l*). The conidia were formed nainly in basipetal succession (Fig. 2*a–f*). Chlamydospores were not ormed.

The fungus was easily isolated in pure culture by picking off conidia. t grew rapidly and produced spores abundantly on maize-meal agar, and ven better on potato-dextrose agar. Like other reticulate hyphomycetes, t formed no networks in pure culture, but spore formation was more rolific, though the conidia were somewhat smaller than those observed n cultures containing nematodes and other fungi, measuring usually 8–24 × 8–12 μ. The branching of the conidiophores was noticeable, but odal development of conidia in whorls down the conidiophore seldom ccurred; in this respect the fungus resembles *A. cladodes* Drechsler (1937).

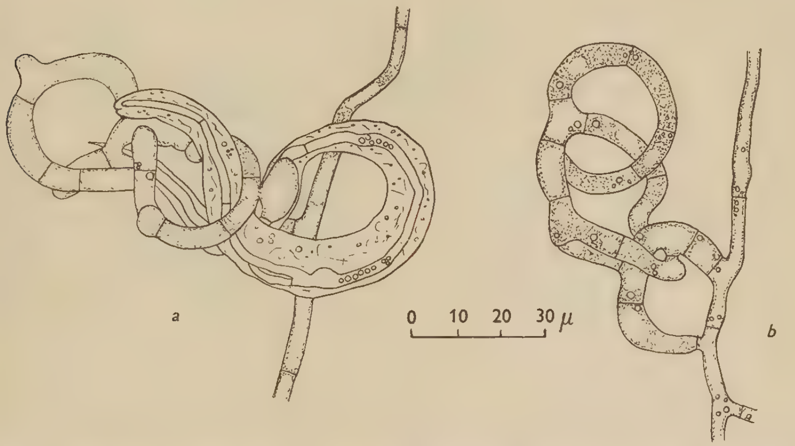

Fig. 1. *Arthrobotrys robusta* n.sp. *a*, nematode captured in networks showing infection bulb and trophic hyphae; *b*, network.

Because of its two-celled, hyaline conidia, and their capitate arrangenent, this fungus seems best placed in the genus *Arthrobotrys* Corda. It liffers from the type species, *A. superba* Corda, in that the fertile hyphae re freely branched, and in the absence of nodal development of conidia n whorls down the conidiophore. Drechsler (1937) suggests that these wo characters should not be regarded as sufficient grounds for excluding species from *Arthrobotrys* if the arrangement of the conidia is truly apitate, and with this view I fully agree. The fungus here described esembles *A. cladodes* Drechsler (1937) and *A. cladodes* var. *macroides* rechsler (1944) in its general habit, differing from the former in the ize of its conidia, and from the latter in both size of conidia and the bsence of enlarged storage hyphae; it is therefore proposed as a new pecies with the binomial *A. robusta*, the epithet referring to its vigorous abit of growth.

In addition to the type collection from near Mickleham, I have foun *A. robusta* in collections from six other stations in London, Cambridgeshire Lincolnshire and Westmorland. A particularly interesting collection wa one of soil from the foundations of a bombed building in St Paul's Churchyard, where *A. robusta* was accompanied by a new species of *Trichotheciur* described below.

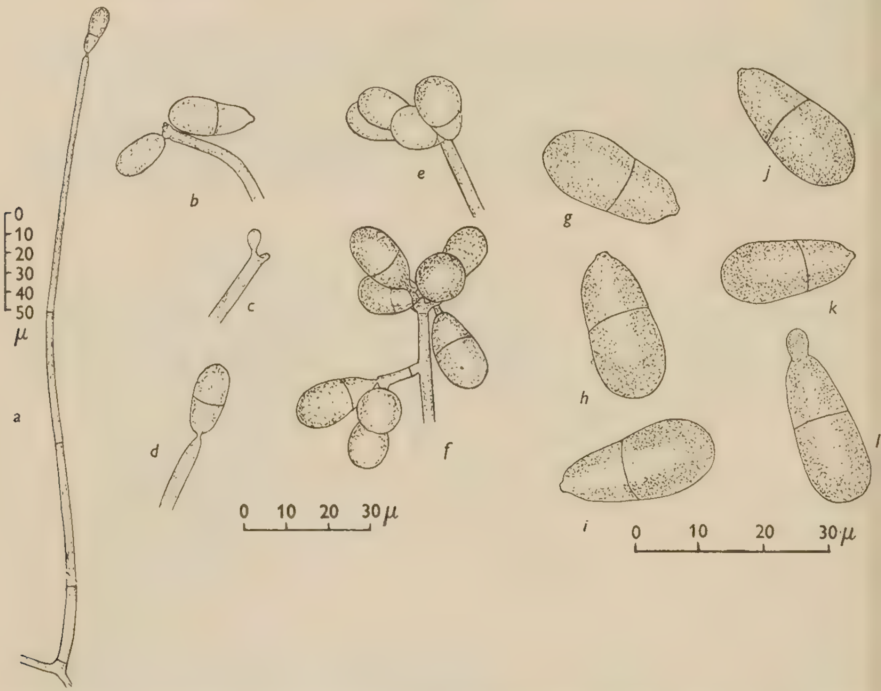

Fig. 2. *Arthrobotrys robusta* n.sp. *a*, young conidiophore bearing a single conidium; *b–f*, stages i development of conidia; *g–k*, conidia from pure culture; *l*, germinating conidium.

Trichothecium cystosporium sp.nov.

Mycelium sparsum, hyphis rectis, septatis, parce ramosis, 3–6 μ crassis, reticula tenaci quae vermiculos nematodeos capiunt evolventibus; tuber infectionis per integumentur vermiculi e quo hyphae edentes excrescunt intrudentibus. Conidia hyalina, lat pyriformia, 25–35 μ longa, 18–24 μ crassa, septo transverso in duas cellulas maxim impares divisa, ad apices hypharum fertilium erectorum 100–400 μ altos aggregata.

Vermiculos nematodeos capiens consumensque in ligno putrido prope Micklehan Surrey, October 1948.

The mycelium consisted of straight, septate hyphae, 3–6 μ wide, sparingl branched and bearing at intervals three-dimensional networks similar t those described above for *Arthrobotrys robusta*. Nematodes coming int contact with the networks were held by adhesion, and capture was followe by the intrusion of an infection bulb from which trophic hyphae sprea throughout the carcass of the animal and absorbed its contents (Fig. 3*a*, *b* The trophic hyphae were about 4 μ wide. They were at first non-septat but septa appeared as they grew older, and later their protoplasmi contents disappeared.

Conidia were formed quite freely, the erect aerial conidiophores rising to a height of 100–400 μ. At the apex of the conidiophore a group of conidia was produced, consisting usually of about a dozen spores, and even twenty or more in old cultures. The first conidium to be formed was terminal; a second would then appear just below it, the first spore often turning to one side as the second grew. Further spores were then formed in basipetal succession. Each individual spore was carried on a short branch of the conidiophore (Fig. 4). The loose group of spores thus formed had the appearance of a panicle, and the fertile hypha often drooped gracefully under the weight of the large conidia.

The conidia were broadly pyriform, 25–35 μ long and 18–24 μ wide, each divided by a transverse septum into two cells of which the distal one was much the larger. They germinated readily, always by a tube from the proximal cell, and the large distal cell often collapsed very early, sometimes before the spore was shed.

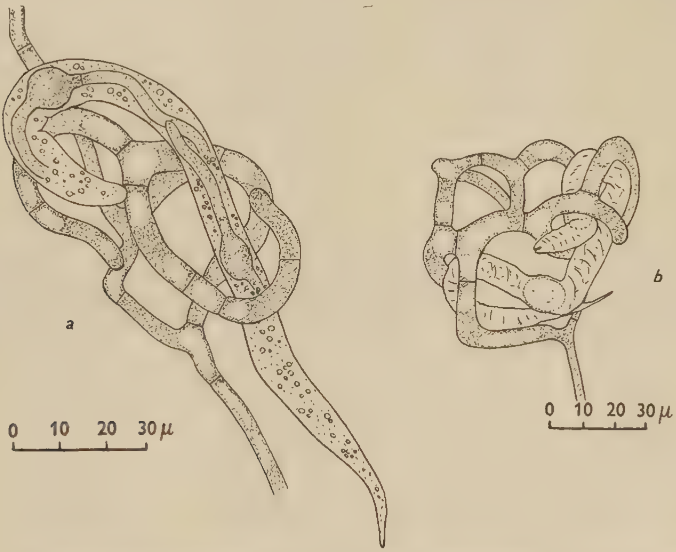

Fig. 3. *Trichothecium cystosporium* n.sp. *a*, *b*, nematodes captured in hyphal networks.

The fungus was isolated in pure culture and grew well on maize-meal agar, producing spores in abundance. The conidiophores were long and straggling, with the spores very loosely arranged, and the conidia, though more numerous than in eelworm-infected cultures, were smaller, measuring 24–30 × 16–23 μ (Fig. 5).

No chlamydospores or resting structures of any kind were observed either in pure culture or when the fungus was grown with nematodes.

This fungus is placed in the genus *Trichothecium* Link because the mode of development of the conidia seems to resemble the condition characteristic of *T. roseum* Link rather than *Arthrobotrys superba* Corda. The branching of the conidiophore is a point of difference from *Trichothecium roseum*, but the erection of a new genus on this point alone does not seem to be desirable at the moment. The successive formation of conidia basipetally down the apical portion of the fertile hypha in *T. roseum* has been described by Bayliss Elliott (1918), and is well known to all who are familiar with the species; in this respect the fungus here described resembles *T. roseum* and differs sharply from *Arthrobotrys superba* as figured by Corda (1839), with its terminal head of spores and further development of spores in whorls.

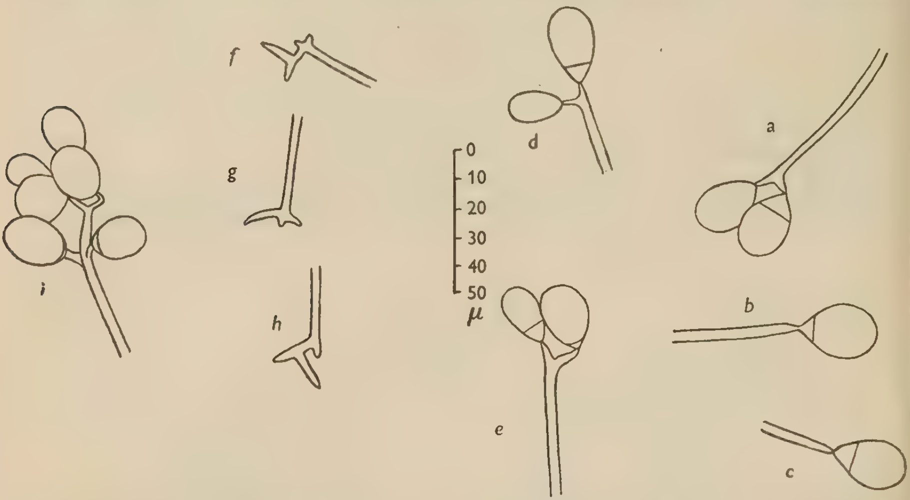

Fig. 4. *Trichothecium cystosporium* n.sp. *a–e*, tips of young fertile hyphae, showing development of conidia; *f–h*, tips of young fertile hyphae with conidia removed; *f* carried four conidia, and *g* and *h* three apiece; *i*, tip of older fertile hypha, bearing six conidia. All from nematode-infected culture.

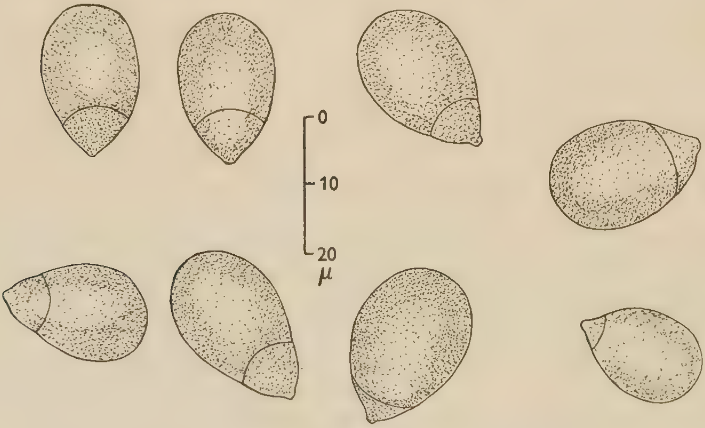

Fig. 5. *Trichothecium cystosporium* n.sp. Conidia, from pure culture.

The conidia of my fungus resemble those of *Trichothecium polybrochum* Drechsler (1937) in shape, but are a trifle smaller; *T. polybrochum*, however, has but one conidium per fertile hypha, and captures nematodes by means of constricting rings. The fungus under discussion is therefore cited as

T. cystosporium n.sp., the epithet referring to the swollen terminal cell of the conidium, which gives the impression of a bladder.

In addition to the type collection from Mickleham, *T. cystosporium* has been obtained from leaf-mould at Solihull, Warwickshire, and from soil from a London bomb site, already mentioned.

Type material of *Arthrobotrys robusta* and *Trichothecium cystosporium* has been deposited in the Herbarium of the Royal Botanic Gardens, Kew, and in the Herbarium of the Commonwealth Mycological Institute, Kew.

All measurements and drawings used in this paper have been made from iving material.

My thanks are due to Mr R. A. Gillanders for his assistance in preparing the Latin diagnoses, and to Mr J. S. Waid and Miss J. M. Laptain for supplying me with the collection of soil from St Paul's Churchyard; especially I should like to thank Dr B. Barnes for his invaluable help throughout the course of the work.

The material here set out has been used as part of a thesis for the Ph.D. degree in the University of London.

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(*Accepted for publication* 3 *April* 1951)

POLYPORUS QUERCINUS ON *FAGUS SYLVATICA*

By K. St G. CARTWRIGHT

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(With Plates 29 and 30)

Polyporus quercinus (Schrad.) Fr. was collected on living beech at Woodstock, England, in 1949. The sporophore, culture and type of decay in oak and beech are described.

Polyporus quercinus (Schrad.) Fr.

Syn. *Ungulina quercina* (Schrad.) Pat.
Piptoporus quercinus (Schrad.) Pilát

The sporophore of this rare species was collected from a living beech tree in Blenheim Park, Woodstock, Oxon, by Dr Kurt Lohwag in September 1949 at the autumn foray of the British Mycological Society. The identity of the fungus was confirmed by Miss E. M. Wakefield. As far as I am aware this is the first record of its occurrence on any host other than oak.

From the scanty records it appears to be rare both in this country and in Europe. Pilát (1936) records it as occurring usually on old living oak trees, also on dead oak trees and on converted timber exposed to damp, but remarks that it has not yet been recorded on other species of wood. He adds that he has found it in mines and that in such situations it forms abnormal sterile fruit bodies. Bourdot and Galzin (1927) describe similar sterile forms which they associate with this species.

Description of sporophore

The fruit body on which this note is based measures 15 × 12 cm. and is up to 7 cm. thick (Pl. 29*a–c*). The upper surface is unevenly furrowed, the furrows running from the short thick stipe to the involute margin. The cuticle is yellowish suffused with purple; the flesh pale and corky in texture. The sporophore becomes very hard on ageing. The tubes are short, being 2–3 mm. long. They are pale when young but darken on bruising and as they age. The basidia measure $14–24 \times 6\,\mu$ and bear four subfusiform pluri-guttulate spores averaging $7–10 \times 3–4\,\mu$. The spores appear white in the mass.

Description of culture

Isolations from sporophore tissue were readily made on to 5 % malt agar, on which the fungus grew satisfactorily. Development is slow, the growth being colourless at first and the hyphae mostly submerged in the medium or growing sparsely on its surface.

Young culture

Mat at first, white with a wide colourless margin and the hyphae growing close on the surface of the medium. Colour develops later in the centre. Growth is similar both in the light and in the dark, but is slower and denser in the light and the colourless margin tends to disappear. At an early stage of development separate colonies often arise from secondary spores. After about 3 weeks the central coloured portion of the culture may measure 3–4·5 cm. in diameter out of a total diameter of 7 cm.

The colour is not readily matched, but the range is between Army Brown (Ridgway) and Natal Brown, though it is often masked with an overgrowth of finer hyphae. The margin of the culture is white at this stage and often raised into a slight ridge, but at the extreme edge the hyphae usually tend to lie flat on the medium. The texture of the mat is dense and homogeneous and there is no tendency for strand formation. The medium tends to become furrowed radially.

Mature culture

In light, a mature culture one month old is coloured Natal Brown but usually tends to become overgrown with a creamy white, woolly mycelium, especially at the upper half of the slant. The agar medium is much darkened in colour.

Microscopic description of culture

The aerial mat is made up of both colourless and coloured hyphae, and abundant rod-shaped crystals are usually produced in the medium and attached to the colourless submerged hyphae. A number of large hyphae with simple clamp connexions are also present.

The main characteristic is the massed production of secondary spores, which may be terminal or intercalary. These spores are extremely variable both in size and shape and, in addition, oidial formation by separation at septa is frequent, this separation often occurring at a septum bridged by a clamp connexion (Pl. 30 *a*, *b*). The maximum size of the secondary spores measured was $25 \times 3{\cdot}5$ and $20 \times 8\,\mu$.

The colour in the coloured hyphae appears mainly to be due to the contents, the hyphal wall being colourless and it resembles that of the laccate crust of sporophores of *Ganoderma lucidum*.

The mature mat in old cultures becomes tough and, on drying, brittle. The tough mat is built up of two sets of parallel hyphae crossing at right angles, thus forming a closely woven mat.

Temperature and rate of growth

The range at which growth occurs is from 5 to 30° C., the optimum being 20° C. Slight growth takes place at 5° C. and growth ceases above 30° C.

DESCRIPTION OF DECAY IN OAK AND IN BEECH

Polyporus quercinus causes a white rot attacking both the lignin and cellulose. Blocks of oak and of beech wood exposed to attack by this fungus for a period of five months lost in the case of oak sapwood an average of over

25 % of their weight, and in beech 15 %, based on the oven-dry weight of the wood. The highest percentage loss in one sample was 33 % in oak and 24 % in beech.

The decayed wood becomes very light in colour, and often shows blackish zone lines which, however, are not so clear cut as those of *Xylaria*. Sections of the wood when examined under the microscope show that extensive gumming is caused, especially in the region of the zone lines where plugs are formed, as in *Fomes pomaceus* and also in *Armillaria mellea*. The plugs, or at any rate a number of them, contain hyphae closely compacted and with bladder-like swellings, again somewhat similar to the 'pseudo-tyloses' formed by *A. mellea*, but it is often difficult to distinguish the hyphae in the abundant amorphous reaction gum. Fine colourless hyphae with clamp connexions are fairly plentiful throughout the wood. In the areas of advanced attack the hyphae are preponderantly dark brown or golden in colour.

The fungus passes from cell to cell through the simple pits and also by direct penetration of the cell walls. The bore holes are at first of small diameter, but in areas of advanced attack large ones which often coalesce are frequent, so that they must become enlarged by enzyme action afterwards. Attack appears to start as a rule from the cell lumen, but hyphae are sometimes present in the middle lamella and cause separation of adjacent cells before any marked delignification has taken place.

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EXPLANATION OF PLATES

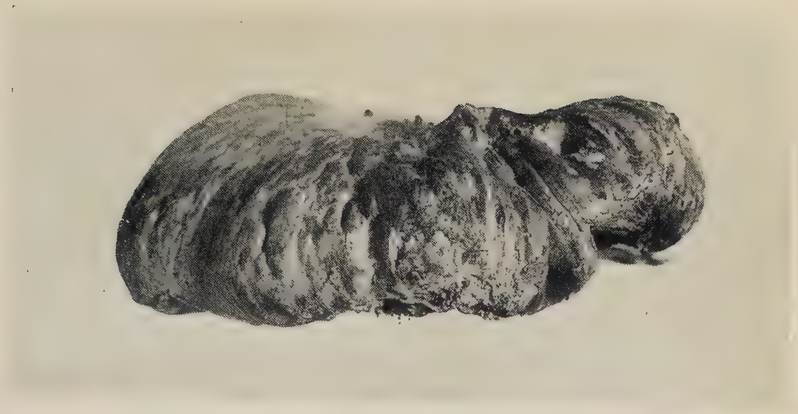
Plate 29

Sporophore of *Polyporus quercinus*: (*a*) upper surface, front view, × ⅔; (*b*) section showing narrow pore layer, × 2 (holes in context caused by beetle larvae); (*c*) pore surface, × 2.

Plate 30

Secondary spores from aerial mat of culture grown on 5% malt agar. (*a*) × 330; (*b*) × 660.

(*Accepted for publication* 6 *April* 1951)



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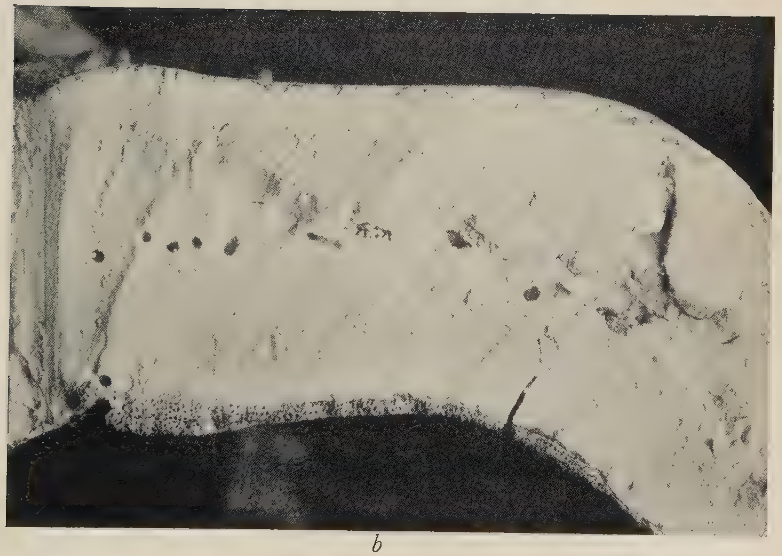

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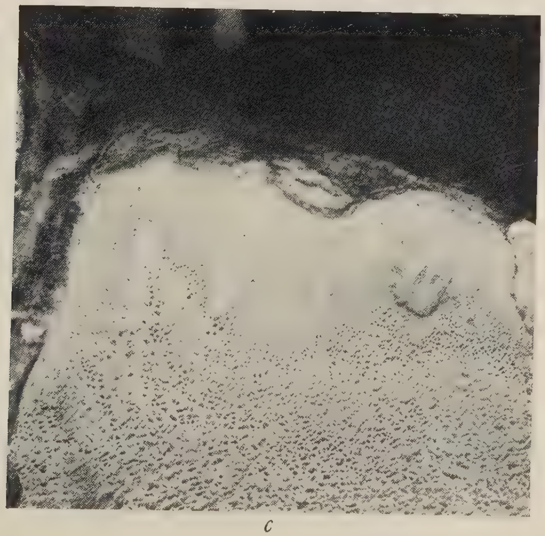

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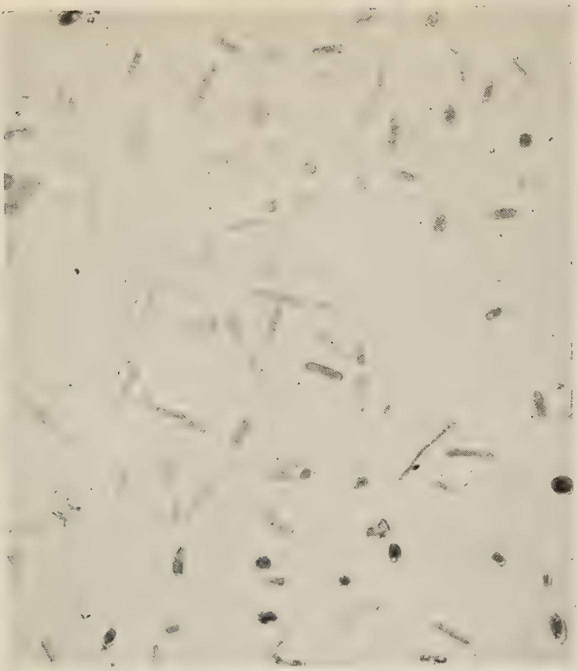

a

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REVIEWS

Danish *Psalliota* Species. By F. H. Møller, in *Friesia*, **4**, 1–60, 1950.

It is worth while drawing attention to this important paper, which it is hoped will be followed by others, and eventually by a complete monograph of the difficult genus *Psalliota*. The paper is described in a subheading as 'Preliminary Studies for a Monograph of the Danish Psalliotae', and deals only with the section *Rubescentes*, those species in which the flesh turns more or less reddish when cut. The section is divided into five groups and twenty-four species are dealt with, of which eleven are new. In addition, ten new varieties and forms are described. The proportion of new species seems unduly large, but anyone who has attempted to study this genus realizes that most of the old species must have been understood in a collective sense, and if these new segregates prove to be constant entities our knowledge is thereby advanced. It is encouraging that the reviewer has already recognized two of Møller's species among her unnamed drawings. In accordance with modern ideas considerable weight is given to microscopic characters, and good drawings are provided of spores and the sterile cells found on the gill-edge. At the same time a warning is put in that spores taken from specimens growing late in the season may give average measurements larger than usual, because such late individuals tend to have a greater proportion of basidia with only one to three spores instead of the normal four. It may be necessary to issue a similar *caveat* about cheilocystidia, since there seems to be some evidence that the shape and size of cystidia may vary in one species either with age or with position on the gill. The paper is well illustrated, having in addition to fourteen text-figures three coloured plates and thirteen uncoloured.

E. M. WAKEFIELD

The Smut Fungi. A Guide to the Literature, with Bibliography. By GEORGE WILLIAM FISCHER. (New York: The Ronald Press Company, 1951.) x + 387 pp. $6.

This book, 'a guide and quick introduction to the literature on the biology and control of some 330 species of smut fungi and the diseases which they cause', is, by implication, a striking illustration of the way in which the activity of systematists has outstripped more detailed investigation. At least another 300 species are missing from the compilation because of the lack of any published information on their biology and control, and the Ustilaginales is an order of considerable economic importance.

Not only students of the smuts, but also plant pathologists and general mycologists, will find occasion to consult this well-printed and useful guide which comprises a bibliography of more than 3300 items (pp. 221–337), indexed according to an alphabetical catalogue of species (pp. 3–217) by a series of standard entries such as culture, cytology, heterothallism and sex, life history, physiologic specialization, and varietal resistance.

The specific names and synonymy have been taken from an as yet unpublished manuscript by the late Dr G. L. Zundel on the Ustilaginales of the World and it may be noted that a number of the new combinations proposed by Zundel in that work will now take precedence from the date of publication of the book under review, February 1951.

G. C. AINSWORTH

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